AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 9, No. 27. WEEKLY. | NEW YORK, JULY 3, 1886. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

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The Morton-Poole Calender Roll Grinding Lathe.

BY JOSHUA ROSE.

In writing the description of the J. Morton Poole roll grinding lathe for my new book, "Modern Machine Shop Practice," I discovered that there were errors in the engravings in the way of lines and centers omitted, as previously published, that were of vital importance to a proper understanding of the action of the machine. These errors I have corrected,and having added some engravings, the construction of the machine may be clearly understood from the following, which is mainly derived from advance pages of the above book. The machine consists of first, a driving head *H*, containing a clutch motion for reversing the carriage, this motion being worked by a tappet arm on the back of the lathe carriage. Second, the rests *B* for carrying the roll to be ground, and third, the carriages *S* and *F*, the latter carrying the slide-rests upon which the emery wheels are mounted.

The peculiarity of the machine consists in the fact that the truth of the roll does not depend upon the truth of the guideways along which the carriage traverses, while, as the emery wheels are in effect a pair of dgrin_ing calipers, absolute parallelism in the rolls is assured, except in so far as it may be affected by the wear of the emery wheels. This wear is, however, but one-half what it is in other forms of grinding lathes.

The bed of the machine is provided with V guideways similar to those used on a planing machine, as may be seen in the end view, Fig. 2.

The sliding carriage is directly guided by the ways it traverses upon in the bed.

The sole office of this sliding carriage is, however, to carry a suspended or swinging carriage, which it does by means of four suspension links, one of which is partly shown at *J* in the end view, while all four are partly visible in the general view of machine. At their upper ends these links are upon shafts *H*, and these shafts rest upon the standards *S*, *S*, *S*, *S*, of the sliding carriage.

It will be seen, therefore, that while the sliding carriage is held fixed (crosswise of the lathe) by the ways in the bed, the swinging carriage *F* is free to swing crosswise of the lathe. The swinging carriage is provided with two slide rests *A*, *A*, upon which are mounted the emery wheels *W*, *W*. The roll is obviously revolved between the emery wheels, which revolve about 5,000 feet per minute, and are traversed along the roll.

Now suppose a roll having been turned is placed in the grinding lathe, its journals resting in the bearings *B*, it will be ground to run true as follows:

In Fig. 3, p. 2 the dot at *Z* represents the axis upon which the roll is revolved, and it is seen that as the roll does not run true, but is high on the side *f*, therefore that side will meet the emery wheel *W* and be ground. When the roll has made one-half a revolution the high side *f* of the roll will meet and be operated upon by the wheel *W*. If the pressure between the wheel and the roll is sufficient it will cause the swinging carriage to move back enough to let the roll pass. This condition of grinding away the high side with one emery wheel only acting at a time, will continue until the roll runs true, when both emery wheels will come into action and obviously grind the roll parallel and straight, because the weight of the swinging rest acts to steady the wheels while the surface of the roll itself acts as a guide to prevent the carriage from swinging after the roll once runs true.

The advantage of using two emery wheels will appear from the following:

From experiments made by Messrs. J. Morton Poole & Co. it was found that using a pair of 10-inch emery wheels it would take 40,000 wheel traverses along an average sized calender roll, to reduce its diameter an inch, hence the amount of error due to the reduction of the emery wheel diameters, per traverse, may be stated as $\frac{1}{40000}$ of an inch per traverse, for the two wheels.

Now referring to Fig. 4, let *R* represent a roll and *W*, *W* the two emery wheels.

Suppose the wheels being at the end of a traverse, the roll is $\frac{1}{40000}$ inch larger at that end on account of the wear of the emery wheels, then each wheel will have worn $\frac{1}{40000}$ inch diameter or $\frac{1}{80000}$ inch radius, hence the increase of roll diameter is equal to the wear of wheel diameter.

Now, suppose that one wheel be used as in Fig. 5, and its reduction of diameter will be equal to that of the two wheels added together, or $\frac{1}{80000}$ inch; this would be $\frac{1}{40000}$ in the radius of the wheel, producing a difference of $\frac{1}{40000}$ in the diameter of the wheel.

The roll is obviously set as near as possible true with the ways of the machine, but a slight error in this respect has no practical value. Thus, suppose an error of even as much as $\frac{1}{16}$ inch exist in this respect at the point of contact of the roll and wheel, the effect would be practically inappreciable, as will be seen in Fig. 6, in which there is marked on the section of every wheel a line denoting its circumference if its center was raised $\frac{1}{16}$ inch.

The method of driving the roll is as follows: The driving spindle *r r'* passes through, and is driven by shaft *t*. A driving pulley is fitted on the spindle at end *r'*, at the other end is a chuck *p* for driving the roll through the medium of a wabbler, whose construction will be shown presently. Spindle *r* may be adjusted endwise in *t*, so that it may be adjusted to suit different lengths of rolls without moving the bearing blocks *B*.

The wabbler is driven by *p*, and receives the end of the roll to be ground, as shown in Fig. 7, the end of the roll being a taper square, and fitting very loosely in a square taper hole in the end of the wabbler; similarly *p* may have a taper square hole loosely fitting the squared end of the wabbler. The looseness of fit enables the wabbler to drive the roll without putting any strain on it tending to lift or twist it in its bearings in block *B*, and obviates the necessity for the axis of the rolls to be dead in line with the axis of *r r'*. Various lengths of wabblers may be used to suit the lengths of roll and avoid moving blocks *B*, and it is obvious also that if the ends of the roll are round instead of square, two set-screws may be used to hold the roll end, being set diametrically opposite, and if set screws are used in *p* to drive the wabbler they should be two in number, set diametrically opposite, and at a right angle to the two in the wabbler, so that it may act as a universal joint.

The method of automatically traversing the carriage *C* is as follows: Referring to Fig. 1, two gears *a b* are fast upon shaft *t*, gear *a* drives *c*, which is on the same shaft as *e*, gear *b* drives *d* which drives a gear not seen in the cut, but which we will term *x*, it being on the same shaft as *c* and *e*. Now, if *e* is driven through the medium of *a c*, it runs in one direction, while if it is driven through the medium of *b d x*, it revolves *e* in the opposite direction, and since *e* drives *g* and *g* is on the end of the feed screw (*E*, Fig. 2) the direction of motion of carriage *C* is determined by which of the wheels *a* or *b* drives *e*. At *h* is a stand affording journal bearing to a shaft *n*, whose end engages a clutch upon the shaft of wheels *c*, *x* and *e*. On the outer end of shaft *n* is a ball lever *l'* whose lower end is attached to a rod *k*, upon which are stops *l' l*, adjustable along rod *k* by means of set screws. At *m* is a bracket embracing rod *k*.

Now, suppose carriage *C* to traverse to the left, and *m* will meet *l*, moving rod *k* to the left, the ball *i* will move up to a vertical posi-

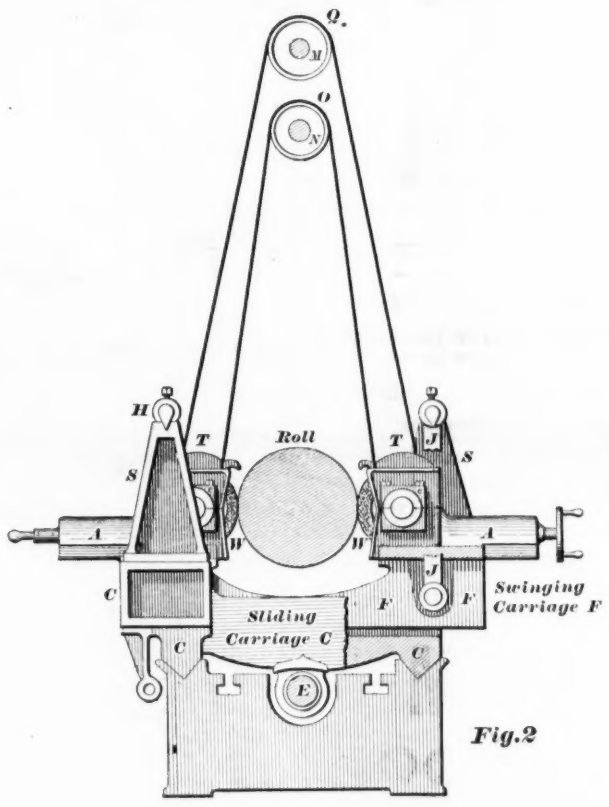
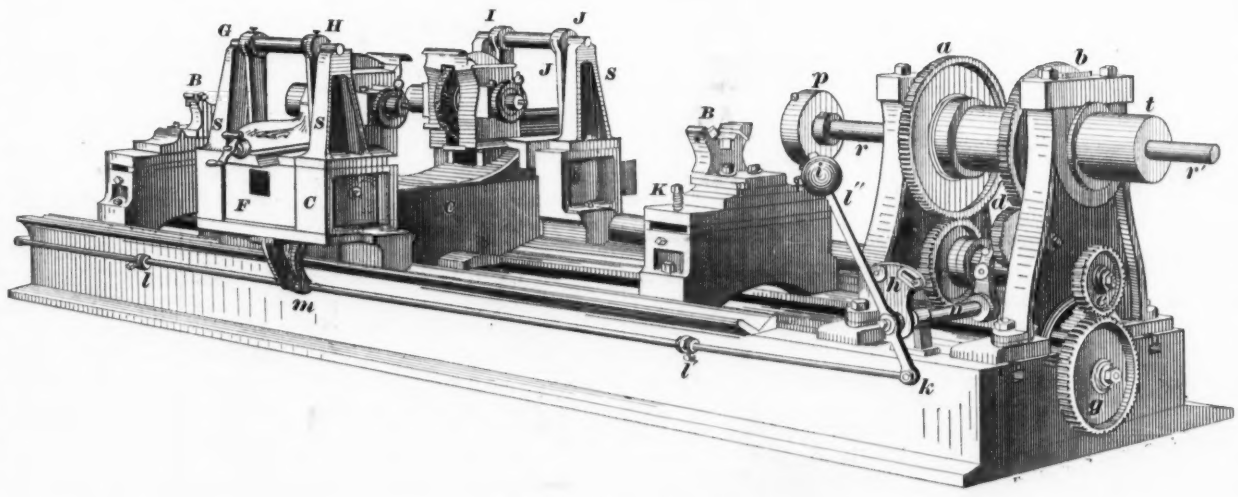


Fig.2



ROLL GRINDING LATHE.

tion and then fall over to the right, causing the clutch to disengage from gear *c* and engage with the unseen gear *x*, reversing the motion of *e* and of *g*, and therefore of carriage *C*, which moves to the right until *m* meets *l* and pushes it to the right, causing *i* to move back to the position it occupies in the engraving, the clutch engaging *c*, which is then the driving wheel for *e*.

This motion corresponds to that used on many old style iron planing machines.

We find the following in the *Locomotive*, published by the Hartford Boiler Insurance Company:

"Defective pressure-gauges are met with about as often as any class of defective fittings that come under our notice. Sometimes we find them wholly inoperative, either through some injury to the mechanism of the gauge itself, or because of some defect in the connections, or obstruction in the pipes leading to the boiler or to whatever the gauge may be connected. Cases of this kind, when the gauge utterly fails to register the pressure, are not so uncommon as one might suppose.

"Generally, however, the most serious trouble we find in testing pressure gauges is an error of a few pounds in their indications of the pressure. So long as this error does not exceed five to ten pounds, either fast or slow, no danger is incurred at ordinary pressure if the boiler on which it may happen to be is a decently good one, and is running with a reasonable margin of safety, but when the error is as much as twenty pounds, or more, it begins to approach what we consider the danger limit.

"As a rule, when a standard gauge is at hand it is a very easy and simple matter to correct any ordinary errors in the reading of a steam-gauge; but a correct gauge for comparison is a necessity, and this is not usually at hand in the majority of manufacturing establishments.

"All the test gauges carried by our inspectors are tested at frequent intervals on our mercury column, and kept adjusted correctly. Gauges sent to this office by our patrons for correction, are always tested in the same manner.

"While there may be some excuse or palliation of the fact that the cheapest gauges made do not, after short service, indicate pressures with that exactness which is very desirable, if not absolutely necessary, in ordinary use, there is none for the fact that gauge manufacturers make and send out gauges intended for standard test gauges, and graduated by pounds up to 200 pounds per square inch, which are as much as two pounds in error; fast in some parts of the scale, and slow in other parts. There is generally no haggling about prices for such articles as these, therefore one would naturally suppose that no manufacturer would send out a piece of work of this kind with his name on it unless it indicated pressures within, at least, a fraction of one pound. There certainly is no good reason why they should, but the fact remains that they do."

In reference to the new bridge which the Baltimore and Ohio Railroad propose to build across the Kill von Kull, it is said it will be of iron, with the necessary draws. The plans are nearly completed; they will be submitted to the United States Government, and when approved, work will be begun at once. The distance across the Kill at the point where the bridge is to be built is 600 feet. The connection with New York will be by five miles of ferriage. The company propose to build fast ferry boats to cover this distance in fifteen minutes.

Early Engineering Reminiscences.

BY GEORGE ESCOL SELLERS.

TWENTY-SECOND PAPER.

At the time I am writing of the old firm of M. & D. Sellers, that dated back to the Revolutionary War, was carried on under the same name by my father, son of Nathan, and his two cousins Samuel and James, sons of David. James was an active member of the Philadelphia Hose Company, and was much interested in experimenting to find a substitute for the hemp or flax thread for sewing hose, not subject to their decay, and that would not be injured by the dubbing and have a lifetime at least equal to that of the leather.

He made a short section of hose sewed with annealed copper wire with a double row of stitching. To have the wire sufficiently pliable to draw the leather close and make a tight seam he was obliged to use a wire considerably thinner than the hemp or flax thread, and owing to the difficulty in inserting the wire in the punctured holes they were made larger, and the leather did not close tightly on the wire, which lacked the swelling property of the thread stitches which had aided greatly in closing the holes. This section was tried fully up to the required pressure, but not without considerable steeping through the stitch holes; at an increased pressure the thin wire cut the leather and the leakage increased. Yet the experiment was considered so far a success that the hose company agreed to bear the expense of further experiments, and Mr. J. Morris and Abraham L. Pennock were appointed a committee with James Sellers to assist him in prosecuting the experiments. Many were tried to render the wire-sewed seams more pliable and to stop the cutting and steepage, but unsucessfully.

The next experiment was by nailing; this at first promised well. A workman, named Andrew Linkfelter, was in the employ of the firm, whose business for many years had been driving tacks in putting together hoops or rims of meal and grain sieves, and who prided himself on being able to so drive a large headed wrought tack, then called a "clout nail," so as to insure a certain and perfect clinch always in the same direction. To him was given the job of putting together the first sections of nailed hose. This was done by lapping one edge of the leather over the other as it is now done with the riveted hose, and driving two rows of clout tacks, clinching them on an iron mandrel. Several sections of 50′ each of hose were so made, and subjected to very severe tests, showing no signs of yielding, but in after tests the clinches began to give way, and finally the seams ripped. This was mainly owing to the swelling of the leather when wet and shrinkage on drying tending to strain and loosen the clinch. The next experiment was driving one row of tacks near the outer edge of the leather as it lapped over, clinching them on the iron mandrel as in the previous case; then a row of holes was pierced near the edge of the inner lap and the tack inserted from the inside with its head resting on the mandrel. The leather was then driven down around the tack by a hollow punch; a row of about a foot in length of these tacks being so arranged with their points exposed, they were turned by a pair of round-nose pliers, clinched and driven home by light hand hammer. This stood the tests well, but it was a tedious and costly process.

My recollection is that during all these experiments James Sellers devoted his whole time and attention to them. Mr. Pennock was almost daily at the shop for a short time, and Mr. Morris only occasionally. I recollect one day when all were present. My father asked if it would not be possible and better to put another head on the tack instead of clinching it. The next move that I remember was seeing my cousin James casting a hard pewter composed of tin, lead and copper into a single rivet or washer at a time in molds similar to the single mold used for casting rifle bullets. In this way the rivets and washers were made for the first section of riveted hose.

The next advance was in making long brass molds in which 15 or 20 rivets or washers in a row were cast at a single pouring. They were afterwards cut from the gates with common hand nippers. A long series of experiments were tried to get a fusible metal hard enough to stand the wear of dragging the hose over the stone pavements, and yet not too hard and brittle to rivet well. The first cast rivets were very badly proportioned, the heads being $\frac{9}{16}''$ diameter and $\frac{1}{16}''$ thick; the shanks of the rivets a diameter equal to No. 6 Birmingham wire gauge, the washers the same diameter and thickness as the rivet heads. As to the length of time that these cast rivets and washers were used I am uncertain. My elder brother and myself of evenings and holidays cast and clipped from the gates many hundred-weight of them.

Next in order came copper rivets and washers. These rivets were headed by hand. No. 8 copper wire was cut into lengths by a machine turned by hand crank, then headed in half dies closed by a lever pressing together spring jaws that carried the dies. This lever was operated by a foot treadle (the old English wrought nail header) and the head was struck by two regulated blows of a four-pound flat-faced hand hammer. The sheet copper for washers was cut into strips of a width that would admit of four or six washers being cut from them; this was fed by hand under two punches, a small one to punch the center rivet hole, the large one that followed to punch out the washer. The hand feed was against a stop precisely as the planchets or disks for coins are cut in the U. S. Mint. When for economy tinned iron rivets and washers came into use the same manner of cutting the wire and heading by hand was continued for years before a cutting and heading machine was invented and adopted, but for punching out the washers and using full size sheets of copper or iron my father invented and constructed a machine; this left the sheets, from which the washers were cut, in a useful form for screens, or for covering cellar windows instead of woven wire, and for various other uses.

This machine, without any alteration as to plan, continues in use to the present time. It is also used for perforating sheet iron or steel for coal screens and for floors of malt kilns.

A wooden straight-edge; a shoemaker's leather knife; a rocker or templet, with points to mark the places where holes for the rivets were to be punched by a hollow leather punch; a hollow set punch to drive the washer home and to bring the leather in close contact were used. This set punch was made like a hammer, with an iron handle with a broad, flattened end; the face of the X end or hammer portion, drilled out to go over the rivet, was faced with steel; the end on which the blow was struck, soft iron. When this set punch was grasped by the handle in the left hand, a turn of the wrist, after the washer was driven home, would bring the edge of the flat end of the handle on to the washer, and hold it down while the riveting blows were being struck; a set punch, to round and finish the riveting; a riveting hammer, an iron mandrel to rivet on, were the entire outfit of tools when the first riveted hose was made. But soon labor-saving machinery had to be invented. First in this order came a ratchet arrangement to feed the strips of copper under the washer punches, instead of the hand feed. This soon led to the machine that I have above alluded to, in which whole sheets of planished copper, 30″ × 60″, the size then imported, and iron sheets o much greater length, utilized what before was waste. Before the machine for cutting the wire into lengths, and by a plunger driven by cam and toggle, upsetting the head forming the rivet, was invented, the germ of all rivet and blank headers for wood screws of the present day, samples of hand-made copper rivets and washers were usually sent to England, and a large invoice imported from Birmingham. The washers were well enough, but the rivets were so rough and irregular in size as to be useless for riveting either hose or mail pouches, and they found their way to the brass-founder's crucible. Screw stretching frames to take the wind out of the sides of sole leather, after they were skirted, and before the hose strips were cut, that the hose in use would keep straight; machines for cutting and trimming, beveling and tapering the ends where the strips of leather were to be spliced together, and simultaneously punching the double row of holes for the spliced rivets; a machine through which the spliced strips of leather were fed, the rivet holes automatically laid out and punched; all these inventions were but the natural sequence of the inven-

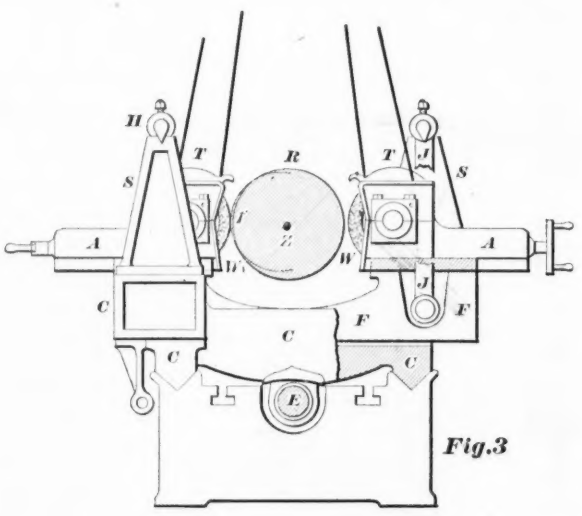


Fig.3

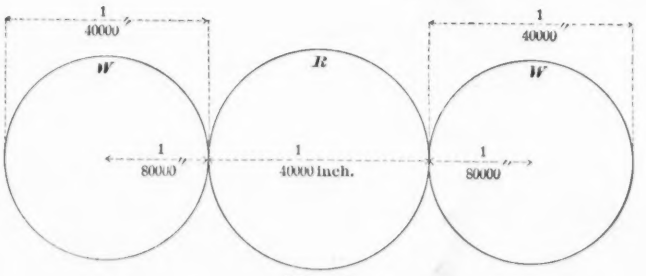


Fig.4

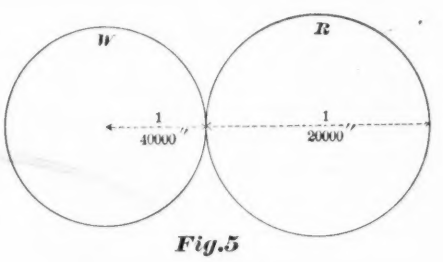


Fig.5

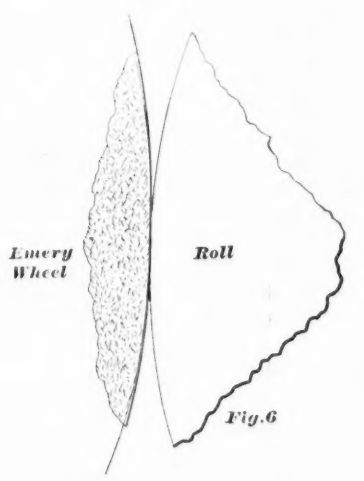


Fig.6

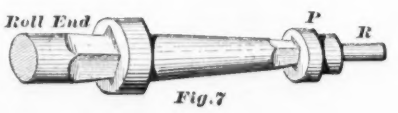


Fig.7

DETAILS OF ROLL GRINDING.

tion of riveted hose, or leather water tubes, as it was called by our English progenitors.

In the year 1818 letters patent were issued to Abraham L. Pennock and James Sellers, as joint inventors, for riveted hose and leather riveted fire buckets, and in the same year a patent for mail bags, either riveted or nailed. About the time, or shortly previous to the applications for these patents, the firm of Sellers & Pennock was formed for carrying on the business of making riveted hose and fire buckets, mail bags and building fire engines. The members of the firm were A. L. Pennock, Samuel and James Sellers and my father. I am this particular, as out of the business, as prosecuted by this firm, arose the most important historical patent case that up to that period had come before the American courts as to the bearing the decision had on the rights of inventors, as it was not by any definite law, but entirely on English precedents, that the case was decided.

Previous to the formation of the firm, the great success attending the use of riveted hose by the Philadelphia Hose Company stimulated other companies, several of which had riveted hose made, but in no instance that I can recall without the written consent of the inventors, which evidently showed their intention to secure their rights by patent.

During the entire term of the patents there were no infringements on the mail bags, which were furnished to the Government by the firm during the term of and for a considerable time after the expiration of that patent. But not so with the hose. In the years 1822 and '23, there were many infringements, not only in Philadelphia, but in other cities. Suit was brought against Adam Dialogue, who was the figure head, being backed by a strong combination, the members of which were known at the time, many of whom were personally known by me, but whom now it would be invidious to name, as none of them are living. The case came before the Circuit Court of the United States for Pennsylvania, and was tried at the October term of 1825 before Judge Bushrod Washington, the highest legal talent being employed on both sides, Charles Chauncy and Horace Binney for the plaintiffs, and Jared R. Ingersoll and John Sergent for the defendants. My recollection of the case, from which alone I am writing, living where I am having no opportunity to refer to reports, and no notes taken by myself at the time, memory alone has to be depended on. I listened to all the testimony, heard the arguments of the attorneys, the judge's charge to the Jury, all of which made a lasting impression. This, taken into consideration with the fact that it was the first case in which I had ever been called on to testify, the only case I had then heard tried, accounts for my being able to recall it after a lapse of over sixty years. It is an historical case, as it and another case decided about the same time and on the same grounds, by Judge Story, became established precedents of vast importance to inventors, and led to modifications of the patent laws, more clearly defining their rights and what they must do to protect themselves.

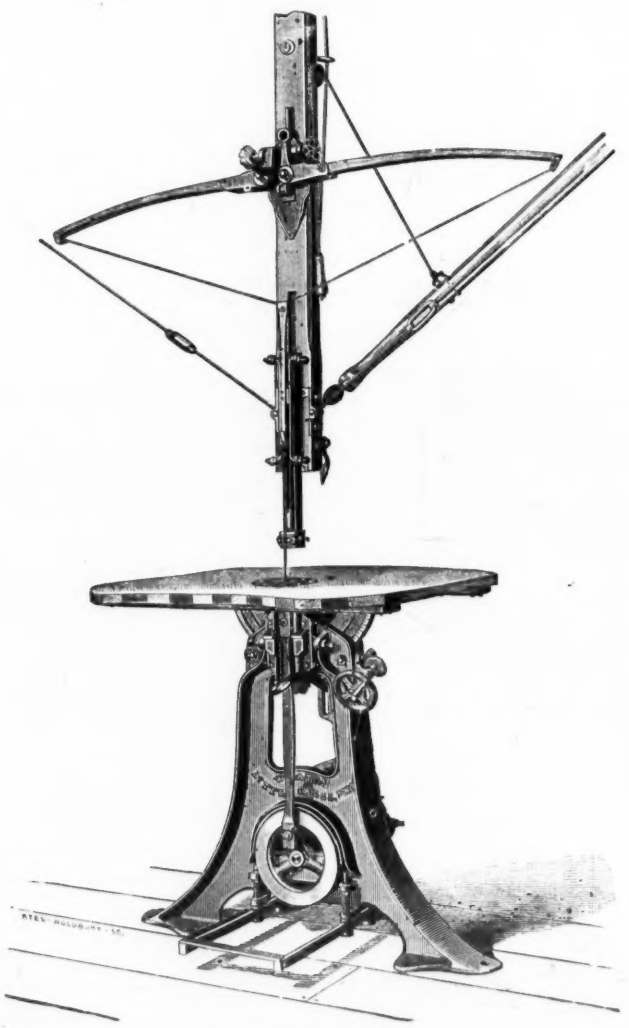
There was very little or no effort on the part of the defense to invalidate the originality of the invention. The ground taken was that as the experiments and the first hose was made for the Philadelphia hose company, under the direction of their committee and at their expense, the invention belonged to them, and as they had not taken out letters patent, it was free to the public. It was shown that the company had not laid any claim to the invention; their committee for the company's benefit carried out the suggestions of Mr. Sellers, and had received no consideration for their services. Our patent laws at that time did not make it obligatory on the inventor to make application for letters patent within any given time. It was argued that in this case Pennock and Sellers had permitted their invention to be used for some months previous to their making application for patent, and therefore it had been abandoned to the public. Many English precedents were cited; one in particular that I remember was the invention of side frames for spectacles. The inventor took his plans to George Adams, then the mathematical instrument maker and optician of the highest standing in London, whose shop, I think, was on Ludgate Hill, who from the plans given made for the inventor the first pair of side frame spectacles. At the same time he made a second pair, which after the inventor had left with the pair made for him he placed in his show window. Within four hours of the time they were placed there, the inventor in repassing saw them in the window. He went into the store, told Mr. Adams that it was his intention to patent, forbade any others being made, purchased this second pair and took them away with him. The mischief had been done; the three or four hours' public exhibition, which was proved by several witnesses, lost the inventor his rights, on the ground of abandonment.

It was such English precedents, and not any fixed law, that governed the court and lost to the American inventors their rights. An appeal was taken to the Supreme Court of the United States, and in January, 1829, the judgment was affirmed.

Improved Scroll Saw.

This machine is designed for pattern maker's use, but will do all kinds of scroll sawing as well.

The frame is built so as to give a broad bearing on the floor, which prevents the sid vibration due to the motion of the reciprocating parts in that direction. The main bearing for shaft is cast solid on the frame, is five diameters in length, and is self-oiling.



IMPROVED SCROLL SAW.

A back support (partly hidden in the engraving) is bolted to the back of frame and extends down to the floor with foot similar to that on frame; this gives the machine a bearing on the floor in three directions, insuring steady running. This support has bearing for back end of shaft three diameters in length with belt pulleys between the bearings, allowing for belting in any direction without interfering with the frame.

The tight and loose pulleys are six inches diameter for 2½" belt, and should make 1,000 revolutions per minute. The loose pulley has extra length of hub, is self-oiling, and runs on a bush. This prevents all wear on the shaft, and the bush can be replaced in case of repairs without much expense.

The belt shipper is constructed to go on to the belt in any direction, and is provided with a brake by means of a leather strap which passes over the top of balance wheel and is connected to the guides through which the shipper rods slide; two coil springs keep the shipper up in place.

The crosshead is made of steel, is very light and runs between gun-metal slides arranged to take up the wear. Oil cups are provided with self-feeders; a durable saw clamp is also provided.

The table is made of strips of hard wood glued together, with battens fastened to under side with round-headed screws, with washer under the head; the holes are slotted to allow for contraction and expansion.

The table can be tilted in either direction by the hand wheel and gears, which drive a worm working in a rack cast on the back of the graduated segment, which is bolted to the table. A spring stop, shown on left-hand side of machine, sets the table level. To adjust the table for bevel sawing, push the clamping handle down, pull out the spring stop, then, by turning the hand wheel, the table can be moved in either direction. When set to the proper angle, pull the handle up to its place, which clamps the table securely.

The saw runs in a steel guide or back rest, adjustable for different thicknesses of saws, and has a guide directly beneath the table, which keeps the saw from springing sideways when sawing thick stuff.

The back rest can be raised or lowered to suit the thickness to be sawed, and clamped securely by an eccentric handle. The top of saw is guided by a light crosshead, which runs in ways adjustable in any direction. The tension on the saw is produced by two wooden springs fitted to iron sockets, and connected together with a cord. To this is fastened a strap, which carries the upper crosshead, and also a steel hood for connecting the saw. More or less strain can be given by the side screws, shown in cut. An eccentric handle holds the whole securely, and allows it to be moved up or down to suit the different lengths of saws.

An important improvement in this machine is that the saw never need be removed, and passed through the work for inside sawing. The main post has a strong hinge at the top, where it joins the ceiling. The back brace also has a hinge at its extreme end and one about two feet from post. To this joint is fastened a cord, which passes over a pulley on the side of the post, and down within easy reach of the operator. By unhooking the saw and pulling on the handle attached to the end of the cord, the whole upper rigging can be swung clear of the table if necessary, allowing the work to be passed over the saw. When swung into position, it is as rigid as it would be without the joints.

The manufacturer is Wyman Eaton, Little Falls, N. Y.

Report of Railway Master Mechanics on Shop Tools and Machinery.

Your committee on shop tools and machinery beg to herewith submit the following report. By dealing with but one subject the committee hoped to gather more valuable and accurate information than would likely be obtained if an attempt were made to cover a larger and wider field. They accordingly caused to be issued for distribution the following circular:

"Please state if you have used milling machines instead of planers for surfacing work. State kind of work surfaced, and difference of time in favor of either machine.

"It is not necessary to give the number of hours occupied by a machine in performing a certain amount of work; the result, if given in form of a percentage in favor of one or the other machines, will answer quite as well, the object being simply to ascertain which is the cheaper method, and to what extent."

Replies to this circular were received from ten members, five of whom reported more or less experience with milling machinery.

Mr. J. Davis Barnett believes that the value of milling begins and ends with small surfaces; that when large surfaces are to be dealt with, the expense of keeping up cutters runs away with all the profit.

Mr. Jacob Johann considers the milling machine as the equivalent of half a dozen special machines, and is decidedly in favor of special machinery.

Mr. A. M. White thinks there is a gain of ten to twenty per cent. in favor of milling, where the work is of such shape that the cutters can work freely.

Mr. H. N. Sprague has milled rod boxes successfully for several years at a much less cost than planing, but is of the opinion that the great cost of cutters for other work neutralizes what advantage the milling machine may have over the planer.

Another member writes that in the establishment with which he is connected milling is almost the only method used for finishing the strap fits of rod boxes. The bottom, sides and ends of flanges are surfaced at one cut, as accurately as can be done by an expert on a planer, and at about half the cost for labor, the same help having been transferred from the planer to the milling machine.

He considers the milling machine as possessing advantages over the planer for surfacing many kinds of both large and small work. When cutters of any considerable size are to be used he thinks they should be made with inserted and adjustable teeth; that is, the teeth should be held in an iron or steel head, as this admits of easily replacing them when they become broken or badly worn.

To those who believe that only small work can be advantageously surfaced by the milling process, he refers to the huge milling machines known as the rotary planer, so successfully used by bridge and roof builders for finishing ends of chords, posts and other members of structural work. Here is milling on a large scale. A cast or wrought iron head in which are held many cutters similar to those of the lathe and planer, simple, cheap and effective, a machine capable of surfacing work 48 inches in width, and of indefinite length, with such rapidity and accuracy that the planer ceases to be a competitor, and he thinks it fair to assume that a similar machine would back off cylinders as quickly and as accurately as it does the work upon which it is commonly engaged.

This member is also of the opinion that the common idea that large milling tools are too expensive to be of practical value is not well founded. Large milling cutters, if fitted with inserted teeth, are not more expensive to keep up than a given number of lathe and planer tools of similar dimensions.

If, however, large cutters have to be made from the solid, thus giving the tool dresser an opportunity to undo the machinists' labor of days and perhaps weeks, we are dealing with unsafe methods rather than with wrong principles; with such cutters the rotary planer would surely become a complete failure as a labor saver; therefore, they who attempt to do any considerable amount of milling with large solid cutters are not likely to become converts to this method of surfacing work. But with the well-designed milling machine and properly constructed cutters, he believes the question of milling and planing will in very many cases be decided in favor of the former machine.

D. A. WIGHTMAN,
A. J. PITKIN,
F. B. MILES,
} Committee.

Simplifying Machines.

Machines as first constructed are usually more or less complex, and invention plays as prominent part in simplifying as in originally creating the device.

It often happens that when other heads study the machine, they are able to improve it by dispensing with a large quantity of the mechanism required by the inventor to perform a given action.

A button-hole machine of very complicated design was recently presented to a machine manufacturer, with the request that he bid for a contract to make the machines in quantity.

It was stated to the writer, by the manufacturer in question, that should he contract to make the machines, about one-half the present complicated mechanism of the machine would be at once discarded, yet all operations now performed by the machine would still be executed.

In another case by the same manufacturer, three machines were required to do, in three distinct operations, certain work on articles made from sheet tin.

By the simplifying method, two machines were dispensed with, and all three operations performed practically at the same time by one machine.

These methods are the true ways of reducing cost of manufacture. We might also add that true invention as applied to machinery, lies not in scheming out a complicated mechanical device for performing given operations, but in reducing the whole matter to its lowest mechanical terms.

Schuhmann's Automatic Cut-Off Engine.

In this engine no especial attention is called to particular form of bed plate or other parts. The particular features are the valve used, and the means employed to bring about sharp cut-off, free exhaust and small clearance.

Fig. 1 shows a plan, and the cut below an elevation of this engine.

The valve gear consists of a main valve with a riding cut-off valve, the latter being driven by a separate eccentric, and the point of cut-off is adjusted according to the load of the engine by the governor raising or lowering, the cut-off eccentric rod thus decreasing or increasing the travel of the cut off valve.

The cut-off valve is connected to a rock arm which is keyed to a rock shaft, and on the outer end of this rock shaft is a curved rock arm, which may be called a segmental arm, over which slides a box sleeve, having adjustable gibs at the ends and trunnions on the sides. The cut-off eccentric rod has a jaw, or double hook, bored out to receive hardened steel bushings, which fit the trunnions on the sliding sleeve; these holes in the jaw are cut out below to allow the jaw to be dropped over the trunnions. Then the steel bushings are pushed over the trunnions and into the bore of the jaw, thus locking the eccentric rod to the sleeves. The bushings are prevented from coming out by little set-screws, as well as by the suspension links from the governor, which are connected to the same trunnions. The governor is of the Porter type; its connection to the sliding sleeve is plainly shown in the cuts and does not need further description.

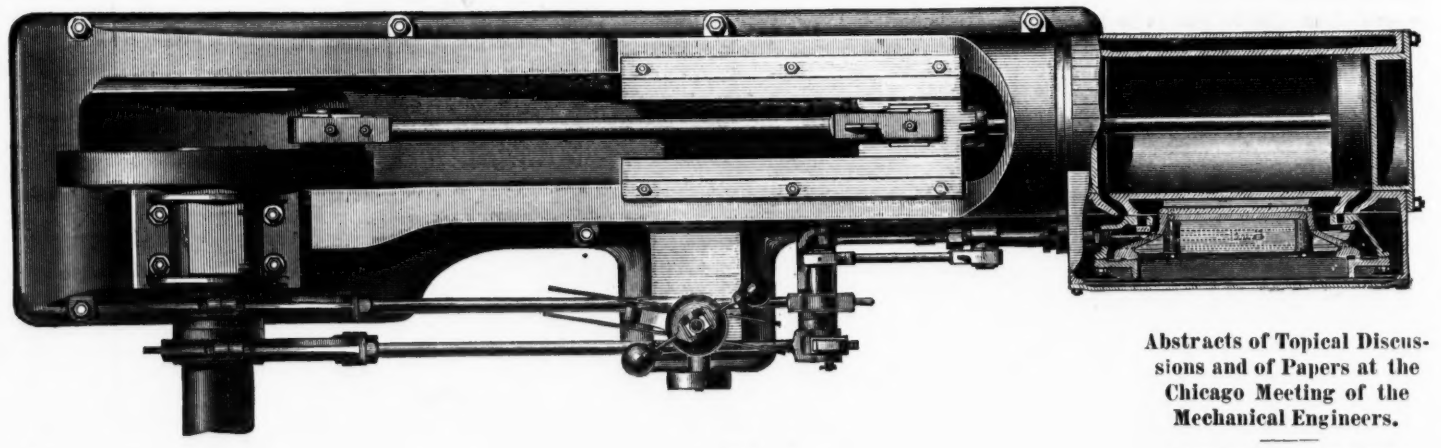
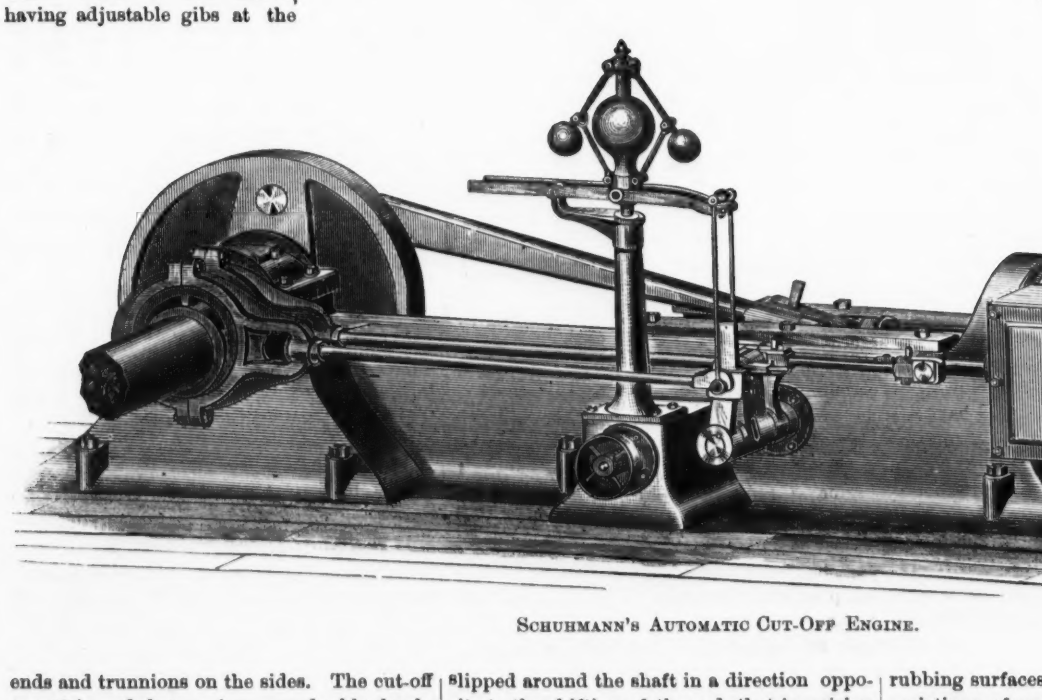


Fig. 1.



SCHUHMANN'S AUTOMATIC CUT-OFF ENGINE.

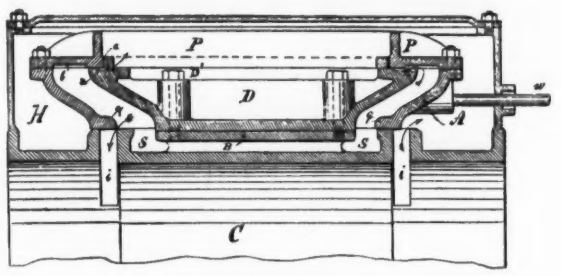


Fig. 4.

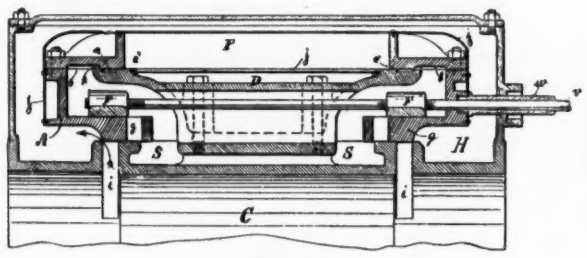


Fig. 6.

It will easily be understood that raising or lowering the sleeve on the segmental arm will increase or decrease the throw of the cut-off valve; at the same time this alters the time of movement of the eccentric, because raising and lowering the eccentric rod has the same effect as if the cut-off eccentric was slipped around the shaft in a direction opposite to the shifting of the rod, that is, raising the rod will make the movement of the cut-off valve somewhat later in relation to the crank motion (assuming the engine to run over), and *vice versa*. This helps to reduce the travel of the sleeve on the segmental arm.

The valve is shown in Figs. 4, 5 and 6. The steam cylinder has the usual steam ports *i i*, but where the exhaust port is usually located, there is in this case a steam chamber *S*, which is in communication with the inlet *J*. A distance piece *D* is bolted to bridge; the upper face of this distance piece is almost an exact duplicate of the valve face on the cylinder, cavities *a a* representing steam ports.

The valve proper consists of frame *A*, to which is bolted the coverplate *P*. The interior of the valve is always in communication with the steam chamber *S*. The balancing of the valve may be described as follows:

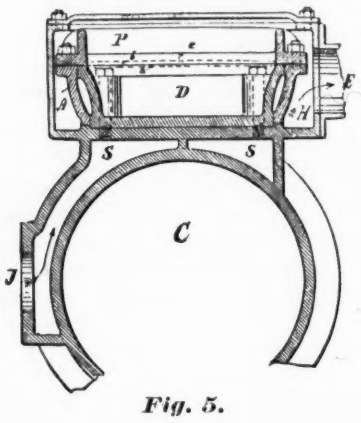


Fig. 5.

The pressure of the steam against the inside of cover *P* is neutralized by the overhang of the valve over the valve seat on the cylinder; the sides of the valve from *A* also project inward (See Fig. 5) in order to counteract the lifting tendencies of the particles of steam that find their way between the rubbing surfaces. In order to neutralize the variations of pressure in the cylinder ports *i i*, a recess *b* is cast in each end of the cover *P*, and this recess is so located that the moment the valve arrives into a position that allows the steam in port *i* to exhaust into the valve chest *H*, live steam will at the same moment enter cavity *a* from the recess *b*, as shown in Fig. 6, or *vice versa*, as shown in Fig. 4. The result is that the pressure forcing the valve to its seat will be uniform throughout the stroke. The cavities *a a* are made very shallow so as not to waste much steam. When used in connection with link motion or other variable cut off, where the exhaust closes early in the stroke (as on locomotives for example), the compressed exhaust steam has a tendency to lift the valve off its seat while recess *a* is still filled with live steam. In order to counteract this, small leak-off holes *e e* are placed in the cover *P* in such a position that when compression begins the steam in cavity *a* will gradually escape.

If the top face of the distance piece was an exact duplicate of the valve face on the cylinder, the valve would be perfectly balanced in every position; but as the slightest leak or jar would cause the valve to leave its seat, it is necessary to have the top face somewhat larger, so as to have a preponderance of pressure towards the cylinder to insure tightness, therefore it is not claimed that this valve is perfectly balanced, but it is claimed that it has less friction than any other balanced valve that takes up its own wear; this will become apparent by considering the absence of packing ring or balance strip friction and the balancing influence of cavities *a a*

Fig. 6 shows the application of this valve with the Meyer cut-off, as suited for marine engines. When used in combination with the Schuhmann's valve gear, the construction is essenlially the same as Fig. 6; this is shown in Fig. 1, and needs no further description.

Abstracts of Topical Discussions and of Papers at the Chicago Meeting of the Mechanical Engineers.

STANDARD PIPE THREADS.

The committee which is considering this matter reported as follows:

The committee has been in communication with the manufacturers of wrought-iron pipe in the United States, and also with the manufacturers of brass and cast-iron fittings. A committee representing the Pipe Manufacturers' Association has been appointed to confer with this committee; there has also been a committee appointed by the Cast-Iron Fittings Association, at a meeting held in New York, May 12, to confer with the Pipe Manufacturers' Committee, to consider the question of a standard pipe thread. A vote was passed at a meeting of the Brass Manufacturers' Association, held in Pittsburgh, May 11, 12 and 13, expressing their approval, and extending offers of hearty co-operation in regard to any action which may be taken by the Pipe Manufacturers to accomplish the desired result in the matter of a standard gauge for pipe threads.

George H. Babcock read an excellent paper on substitutes for steam. He showed that almost from the time of Watt efforts had been made to supersede steam by the use of some other fluid than water. These efforts he concluded had not up to this time been successful. He says:

"As is well known water has the highest specific heat (with two exceptions only, bromine and hydrogen) of any known substance, and in passing from a liquid state to a vapor it renders a larger quantity of heat latent than any other known liquid."

These facts were taken to point to a probability of economically supplanting water as a fluid for vapor engines. Since the development of the dynamic theory of heat he thought that such wild statements as are made regarding the efficiency of other fluids as compared with water, were not creditable.

The author then goes on to describe Cartwright's engine, in which it is proposed to use "ardent spirits or ether." He then goes on to describe other forms of engines, and, amongst other conclusions, arrives at the following:

It becomes evident, therefore, that a successful substitute for steam in motive power cannot be found among vapors, and most probably, if found at all, it must be among permanent gases. By a bountiful provision of nature, an equally free and exhaustless supply of a perfect gas—atmospheric air—has been provided, which has several elements of value in the problem. As it requires 500° of heat to double its pressure at 39° Fahr.—the point of greatest density of water—it may be heated to a very high temperature before it reaches a practical limit of pressure. It is a poor conductor of heat, and does not condense when cooled; therefore it will suffer less loss from being used in a cool cylinder. Being a supporter of combustion, the fuel may be burned within the working fluid, and the loss due to the furnace avoided. It also offers the opportunity of recovering a larger share of its rejected heat to be used again. In a steam engine the only use to which this rejected heat can be put is in heating the feed water and air for combustion, and only a small fraction, not over $\frac{1}{6}$, can be utilized in that way, while with air, Rankine estimates that as much as 90 per cent. of the heat in the exhaust may be retained for use, by a device invented by Stirling, known as the "economizer" or "regenerator." There are disadvantages, however, peculiar to air, among which are its bulk and the necessity of initiating motion by external power. The former is overcome by compression before heating, and the latter may yet be provided for in some simple manner.

* * * *

Are there still further possibilities of economical development of power? Probably not in the line of pressure engines. But science already points to the possible conversion of heat directly into electricity, and if that can be done without too great a loss, the electrical engine may yet become a prominent rival of the steam or air engine. The conversion of 90 per cent. of electrical energy into mechanical work is not beyond reasonable expectations, even if it is beyond present attainment, and if the heat of combustion can be converted into electricity with a loss of only 10 per cent.—which is supposable—we then should get a horse power for .22 of a pound of coal per hour. This would be a saving of 30 per cent. over the best probable result with air engines, or 85 per cent. over the best results yet attained with steam.

With these possibilities before us and the still further possibility of the direct conversion of heat into available power with not over 10 per cent. loss—by some means yet to be discovered—who shall say there is not ample scope for invention and experimental research? We may, however, safely conclude that it lies not in the line of "binary engines," or the substitution of other liquids for water, or other gases for air.

Is steam, therefore, doomed to be superseded? By no means. Even if robbed of its position on the throne of power, it must ever remain one of the most useful servants of man. Its large specific and latent heat render it the best attainable medium of transferring heat within a certain range of temperature, from the furnace to the place where it may be wanted for various processes, and even now it fills a larger field in that direction than it does as a prime mover. So far as now appears, it need fear no successful substitute in that field.

Mr. Crane presented a lengthy discussion of the paper, mainly in the line of showing remarkable results obtained from tests of the carbon bi-sulphide engine.

Remarks were made by several members condemnatory of this engine. Mr. Walker thought it might show good economy, but it created offensive odor, and was otherwise objectionable and dangerous.

Mr. Crane said there was no odor from the engine he tested.

Mr. Babcock thought it might be possible to prevent the odor long enough for a test, but not for any great length of time. He called attention to the fact that while this engine was in operation in New York, permission could not be obtained for a fair test to show whether it was doing what was claimed for it.

When large quantities of bolts are cut it takes considerable time to run the nuts on them. We noticed at the Chicago, Rock Island and Pacific Railroad shops, at Chicago a simple device to save time in doing this. It was simply the bell mouthed center sometimes used by machinists for driving round rods in hand tooling or polishing the ends, in which friction between the surface of the bell mouth and the work does the driving.

A center or chuck of this kind is mounted on a spindle in a head on the bench by the bolt cutter. This runs at high speed. A nut is started on the bolt, one thread then pushed into the bell mouthed chuck it is turned on the desired distance about as quick as it can be handled It is one of those simple things, costing about ten dollars, that saves a good deal of time in a year.

We noticed at these shops that only two sheets are used for the circular shells of boilers. These are $\frac{1}{2}$" thick, a little heavy to handle, but make nice work.

Mr. Twombly places the throttles of all road engines in the front end, with outside connection.

The standard shrinkage for steel tires is $\frac{1}{1000}$ the diameter.

The fare on the Second and Ninth avenue elevated roads has been reduced to five cents for the entire day. The result is that travel on these roads between commission hours has more than doubled.

One Cause of Fire from Smoke Stacks.

BY ROBERT E. MASTERS.

Some time ago the AMERICAN MACHINIST contained an article, which said in substance: If the real origin of many fires that were charged to incendiarism could be traced they would be found to be the result of carelessness, thoughtlessness, or spontaneous combustion from storing away greasy waste, overalls, etc.

Here is a case (which comes under the head of the first two named causes) of a fire in the engine room of an elevator, and situated as the elevator is in the neighborhood of lumber yards and factories, with the wind blowing a gale at the time of the fire, would have resulted in serious loss had it not been for the active service of the fire department which kept the fire confined to the engine room until it was extinguished.

There had been no fire in the furnace or anywhere about the elevator, except in the stove in the office, for three days, and they were at a loss to know how the fire originated. After the fire, several, myself among the number, went into the engine room to investigate. We found on the side of the stack that had an arched opening in it, the engineer had built a closet, the wall of the stack forming one side of the closet, the archway in the stack inside of the closet with a thin piece of sheet iron nailed over it.

When digging around among the rubbish in the bottom of the closet to see if I could find the remains of any greasy waste or overalls, I noticed the smoke coming through between the brick wall and the sheet iron plate, there being quite a crack where the sheet iron had kinked in places between the nails. I procured a bar and pried the sheet iron off, and found the soot in the bottom of the stack all on fire, not a drop of water from the hose having come in contact with it. As soon as the proprietors of the elevator saw this, they felt satisfied it was from that the fire originated.

The sketches Figs. 1 and 2 will give an idea of the situation before the fire, and may

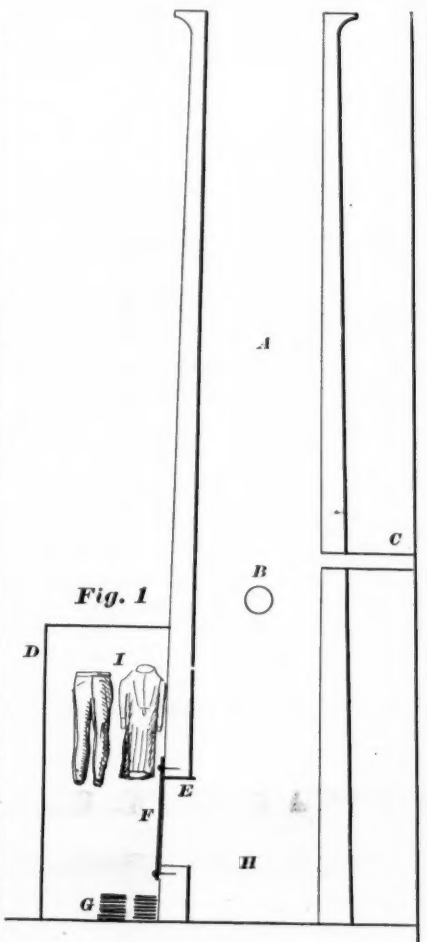


Fig. 1

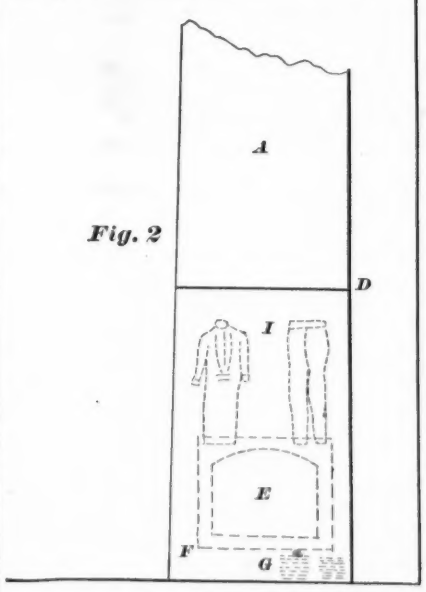


Fig. 2

FIRE FROM SMOKE STACKS.

prove a caution to others. Fig. 1 is a view standing in the engine room looking towards the stack and into the closet; Fig. 2 side view of stack looking through the closet; *A* is stack; *B* pipe from furnace of portable engine; *C* pipe from office stove, from which it is thought the soot ignited; *D* closet; *E* arched opening into stack; *F* sheet iron plate nailed over arched opening; *G* piles of hemp and rubber packing in the closet right under plate *F*; *H* pile of soot found on fire after fire department had left; *I* clothing hanging in closet on the side of the stack and back part of the closet directly over plate *F*.

The conclusions were that sparks from the soot had got among the clothing or in the hemp packing, but had this fire occurred a little later at night it would no doubt have been charged to incendiarism.

LETTERS FROM PRACTICAL MEN.

Locomotive Firing and Management.

Editor American Machinist:

I have noticed in mechanical journals of late more than the usual criticisms on the extravagant use of fuel by locomotive firemen. With an experience of ten years as fireman and engineer it seems to me that there is room for criticising some of these criticisms.

Amongst other suggestions for saving fuel the premium system is strongly advised. Those who advise this show, I think, sometimes a lack of sufficient information on the subject. In the first place do locomotive firemen show less intelligence in performing their work than those firing other kind of boilers, or than men engaged in other kinds of work in this country? I am inclined to think they do not. We cannot expect all the men engaged in any kind of work to give it their whole attention, or to perform the work as carefully and intelligently as they might do. Further, a green man in firing, or in doing any other kind of labor, cannot be expected to do it as well as a man who has been at it for a considerable period.

A locomotive fireman who has been on a locomotive three or four years is generally a good fireman and economical in the use of fuel, from the simple fact that it is usually easier to keep steam upon an engine when the firing is done carefully and intelligently, than when it performed indifferently and carelessly.

The premium system will not always work just right, for the following reasons: All locomotives are not exactly alike, even of the same class or build. The same attention is not given details when engines are being overhauled in different shops. There is difference in the work performed. Different fuels are used, and there is difference in the water in use on different lines. Some roads, noticeably the P. R. R., have adopted the premium system, but they have each class of engines as nearly alike as possible, and also notice particularly any slight improvement that may make the operation more economical. In general railway practice the design of boiler has something to do with the economical use of fuel, as for instance engines with deficient heating surfaces will require more draft and more hard firing than one with sufficient heating surface, in order to keep the necessary steam pressure to do the work required. A fireman on the former engine will have all his attention directed to trying to keep steam up by any means possible, and will give but little attention to economical methods that may be suggested to him. A great many locomotives are not provided with proper dampers at each end of ash-pan, therefore, when the engine has steam shut off there is a continual rush of air into the fire-box that causes the fuel to be consumed rapidly and wastefully, and also causes the steam to increase in pressure and waste away at the pop valve. It might be truthfully said that the waste of fuel from unnecessary draft alone is enormous; also that it might be easily remedied. Some roads do not keep the mud washed out of their locomotive boilers as thoroughly or as often as they might, and it is a fact that many boilers have very inadequate openings to enable the men who wash them to get all the mud out. Frequently flues are more or less stopped up. Engine may be blowing or valves a little out of proper adjustment, so that locomotives are not always theoretically perfect.

Something might be said about the way some engineers keep the water line continually fluctuating, or of the way they use steam in the cylinder, although it may be said in palliation for these offences that engineers are generally expected to make time if possible, and engines are usually loaded to the utmost limit, in fact frequently overloaded, so that it is impossible to give economical management of the engine all the attention that it may deserve.

It is a well-known fact that many advances have been made of late years in draft appliances for locomotives, and we hear of some improvement almost every day; still, it is a

notorious fact that there is more fuel consumed in the most economical locomotive than there ought to be, and we may confidently hope that draft appliances may be still improved so as to reduce the fuel consumed at least from one-third to one-half the present amount.

To conclude, why do not some of the wiseacres, who have so much to say about careful firing and the waste of coal, get up some plan whereby the great waste of exhaust steam may be saved and the heat in it turned to some good account instead of being ejected from the smoke stack? It must be accomplished, if at all, without increasing the amount of machinery, as there is really too much of that about a locomotive at present. J. J. C.

Convention of Railway Master Mechanics.

The Nineteenth Annual Convention of the American Railway Master Mechanics' Association, in Boston, last week, was one of the most successful since the Society was founded. With an attendance of over a hundred members, representing thousands of miles of rail road, from Maine to Texas, and two or three times as many visitors, including a large number of ladies, the interest was never allowed to flag from the first session on Tuesday morning until the final adjournment on Friday. Thursday being the anniversary of the Battle of Bunker Hill, and a full holiday in Boston, no session was held on that day. Everything that Boston people could do for the members, their wives and friends in attendance, to make their stay pleasant, was done. A dinner, excursions and social entertainments at the hotel headquarters were some of the pleasant features that will long be remembered.

The session on Tuesday was opened with prayer by Rev. Dr. Perin, and a welcome address by Mayor O'Brien. Next came an excellent address by President Barnett, the Secretary and Treasurer's reports, topical discussions, and the reading and discussion of regular committee reports.

The following committees reported: Improvement in Boiler Construction; Standard Driving Wheel Centers, and Standard Sections of Tire; Driving Wheel Brakes; to What Extent is Their Use Advisable, and Best Method of Application; Balanced Slide Valves; Best Plan of Cleaning, Removing and Resetting Flues; Shop Tools and Machinery; Hammer Blow Test of Locomotive.

The Secretary's and Treasurer's reports showed the Association to be in a good condition, both as to membership and finances. There were ten honorary, fourteen associate, and 245 full members, making a total of 264, as against 236 last year. Several new members were added during the sessions of the Convention. All bills had been paid, and a balance of over $400 was on hand. This was exclusive of the "Boston Fund," which now amounts to $5,600.

Among the members present were the following: J. Davis Barnett, president, Midland R. R., Port Hope, Ont.; William Woodcock, first vice president, Reading R. R., Elizabeth, N. J.; Jacob Johann, second vice-president, Chicago & Atlantic, Huntington, Ind.; J. H. Setchel, secretary, Brooks Locomotive Works, Dunkirk, N.Y.; Geo. Richards, treasurer, Boston & Providence, Boston; H. Anderson, Chicago; R. W. Bushnell, B. C. R. & N., Cedar Rapids, Ia.; John Black, C. H. & D., Lima, O.; R. H. Briggs, C., O. & S.W., Elizabethtown, Ky.; F.G. Brownell, B. & L., Burlington, Vt.; Chas. Blackwell, N. & W. Roanoke, Va., John Bean, C. & C., Canton, O., John Campbell, D. V., Delano, Pa.; N. E. Chapman, Philadelphia, Pa.; H. L. Cooper, L. E. & W., Lafayette, Ind.; John S. Cook, Georgia R. R., Augusta, Ga.; Allen Cook, C. & E. I., Danville, Ill.; M. L. Collier, W. & A., Atlanta, Ga., W. C. Ennis, N. Y., S. & W., Wortendyke, N. J.; L. Finlay, Little Rock, Ark.; W. A. Foster, Fitchburg R. R., Fitchburg, Mass.; I. W. Fowle, V. & M. & N. O. & N. E., Meridian, Miss.; G. A. Ferguson, B. C. & M., Lake Village, N. H; A. Fenwick, G., B., W. & St. Paul, Fort Howard, Wis.; H. D. Gordon, P., W. & B., Wilmington, Del.; W. L. Gilmore, L. S. & M. S., Cleveland, O.; M. L. Hinman, Brooks Locomotive Works, Dunkirk, N. Y.; John Headden, Rogers Locomotive Works, Paterson, N. J.; B. R. Harding, R. & G., Raleigh, N. C.; J. C. Haggett, D., A., V. & P., Dunkirk, N. Y.; Geo. Hackney, A., T. & S. F., Topeka, Kan., N. W. Howison, C. & P., Mt. Savage, Md.; J. N. Lauder, Old Colony, Boston, Mass.; H. L. Leech, Boston; Wm Lannon, Washington, D. C.; James Meehan, C., N., O. & T. P., Ludlow, Ky.; G. F. Morse, Portland Locomotive Works, Portland, Me.; Jas. McGlenn, Carolina Central, Laurenburg, N. C.; J. S. McCrum, M. R., Ft. S. & G., Kansas City, Mo., Wm. Montgomery, N. J. Southern, Manchester, N. J.; Thos. Millen, N. Y. C. & N., New York; C. W. Mills, R. & P., Rochester, N. Y.; L. C. Noble, Houston & Texas, Central Houston, Tex.; L. B. Paxson, P. & R., Reading, Pa., P. J. Perrin, Taunton Locomotive Works, Taunton, Mass.; G. H. Prescott, T. H. & I., Terre Haute, Ind.; John Player, C. of Iowa, Marshalltown, Ia., Amos Pillsbury, Eastern, Boston; E. M. Roberts, Ashland Coal & Mining Co., Ashland, Ky.; W. J. Robertson, Cent. V., St. Albans, Vt.; W. A. Stone, N. Y. & N. E., Norwich, Conn.; Henry Schlacks, Illinois Central, Chicago; D. O. Shaver, P. R. R., Pittsburgh, Pa.; H. N. Sprague, Porter Locomotive Works, Pittsburgh, Pa.; Wm. Smith, B. & M., Boston; G. W. Stevens, L. S. & M. S., Cleveland, O.; W. H. Selby, Moberly, Mo.; O Stewart, Fitchburg, Charleston, Mass.; F. A. Stinard, N. Y. & G L., Pompton Junc., N. Y.; W A. Short, O. & L C., Malone, N. Y.: H. Tandy, Canada Locomotive Works, Kingston, Ont.; F. M. Twombly, Old Colony, Boston; T. B. Twombley, C. R. I. & P., Chicago; A. W. Twombly, Taunton, Mass.; W. F. Turreff, C. C. C. & I., Cleveland, O.; J. K. Taylor, B. & L., Boston; John Thumser, Seymour, Ind.; A. B. Underhill, B. & A., Springfield, Mass.; S. W. Wakefield, C., R. I. & P, Keokuk, Ia.; J. E. Wiggins, S. P. & T. N., Marshall, Tex; D. A. Wightman, Pittsburgh Loco. Works, Pittsburgh, Pa.; H. A. Whitney, Intercolonial, Moncton, N. B.; M. N. Forney, New York; F. W. Dean, Taunton, Mass.; F. B. Miles, Phil.; Angus Sinclair, Chicago; James Sedgely, Cleveland, O.; Charles A. Ball, Brooklyn Elevated, Brooklyn, N.Y.; C. W. Walker, Portsmouth, Va.; W. N. Fahaven, Allegheny, Pa.; G. W. Ettinger, Richmond, Va.; Isaac W. Clark, Fayetteville, N. Y.; E. L. Weisgerber, Newark, O.; C. E. Smart, Mich. Cent., Jackson, Mich.; L. M. Ames, Jersey Shore, Pa.; G. A Coolidge, Charlestown, Mass.; Clem Hackney, A. T & S. F., Topeka, Kan.; H. D. Garrett, P. R. R., Philadelphia.

PRESIDENT'S ADDRESS.

President Barnett opened his address by expressing his pleasure in meeting and greeting the members again. He believed that Boston is the most charming city to visit on the continent, and referred to the convention held there fourteen years ago, when the association was welcomed and its finances then strengthened. He was glad to say the treasurer and secretary's reports showed a balance on the right side, and mentioned with sorrow and regret that five members had gone over to the majority since last year's convention. After a pleasing reference to the presence of so many ladies, the president continued as follows:

This morning, more particularly to our working and junior members, I wish to speak a few words on the "uncertain in locomotive engineering," and how we can best reduce it. The certain is the concrete results of past experience; it is familiar, prosaic, and it fails to keenly interest or stir us; but that which is still uncertain, still undefined, the test or experiment our friend has in hand, the problem we are trying to solve—these unconsciously draw out our enthusiasm—as we thus hope to obtain one more point of indisputable fact, to make the foundation of our daily practice more firm, to take another and a closer grip on nature; and it is this continually obtaining, this breaking down of the barriers, this wider survey and clearer plotting of what recently was an unknown territory, that gives the growing interest to our profession, and to these our annual reunions.

Critics (and not necessarily unfriendly critics) have said that individually in convention we make contradictory statements, and collectively our published proceedings are conspicuous by the absence of definite conclusions and formulated results.

It seems to me that there is small cause for wonder that statements appear to be contradictory, when it is considered how numerous are the differences in metal, in fuel (and I can add, in men); how great the variation in service the materials are put to; and also over how many substances one word is stretched to cover. May I illustrate? We commonly use the words "soft coal" as it were a single definite, almost elementary substance, ignoring the fact that the varieties from the same bed and seam are numerous, and that two specimens which chemical analysis shows to have practically equal percentages of the same constituents, are seen to behave very differently when distilling on the grade, yielding different residues, as well as showing large variation in calorific power.

"Steel" is another common instance in illustration. What a bewildering variety of substances with highly differentiated qualities does this word cover, and how wide the differences necessary in its treatment, from tool steel injured by high heat to boiler plate, which is made dangerous to human life if it has been worked at low or colorless heats.

Therefore, when circumstances so greatly differ, and the use of a similar word is so far from implying that a similar substance is referred to, should it be a matter of surprise if a member's statement that so-and-so is black is directly followed by another's that it is white?

The thought I desire to impress upon you is the necessity for noting and fully stating all the qualifications or circumstances limiting the observed fact; we shall then see these apparently diverse statements fall into parallel line, and the conclusion (in many, if not most, cases endorsed by the majority) show that it is grey, or a mixture both of black and white.

All the circumstances qualifying, influencing, or seemingly only coincident with an observed experiment, should be noted. For the trend of modern scientific research, is to show that it is the small circumstance (so small and apparently so trivial as to be overlooked for years) that proves to be the missing link, the missing ward in the key that unlocks the puzzle, showing the complete yet simple operation of cause and effect.

We need to educate the closely observant eye, that will not be deceived by superficial appearance into lazily concluding that the apparently familiar result is exactly the old well-known incident, with nothing but the old lesson to teach, and the old law to enforce.

Hence the value of seeing any fact in physics, or any experiment, with our own eyes; and also, because of the liability to usual deception, of seeing the same thing through the eyes and mind of one or more independent observers, of noting the points brought out, that to them seem most prominent and closely related, the sequence or order in which they follow, and their relative proportion to and influence the one on the other.

We can, I think, best get into this good habit—considering the pressing limitations due to time and business calls—by free, mutual exchange of experiences, and our Association is based on that belief, but each statement we make, to be current at its full value, must be specific, something more than a flat contradiction, or an "I don't think so." Let us strive to give the why, as well as to state the naked fact, that in our observation it is so.

We can by striving get the why; for it is certain that regularity and eternal law reign throughout the most diverse results. This is our unshaken foundation. If results seem to vary, it is because we either do not know, or have not observed the conditions that insure success. The defect is in ourselves, for nature's laws know "neither variableness or shadow of turning." Open eyes, unblinking observation, energy and freedom from foregone conclusion are necessary; not that nature is deceitful, but she does not disclose her hidden charms except to those who ardently seek them.

Foregone conclusions are a fruitful source of error. Let us for an illustration turn again to steel, used successfully to sustain rolling friction, yet a failure when inferential reasoning led to its application to resist rubbing or sliding friction. To make a fair trial of the rolling of steel tires on steel rails, was to recommend the exclusive use of steel, it did its work so well, had so long a life, such little frictional resistance, and possessed such high powers for resisting abrasion; yet the attempt to slide one polished steel face upon another, as an eccentric inside its strap, or a crosshead upon its slide bar, has not to-day reached the stage of successful experiment.

It is now clear, that any inference obtained from experiment in rolling friction between metals, will not apply to sliding friction. To think you can do so, is a futile attempt to get at nature's law by a foregone conclusion. The same may be said of any attempt to apply resistance rules deduced from friction at low velocities to practice at high velocities, and it was unwise to expect that boiler plate with $\frac{1}{300}$ part of carbon would behave the same as if it contained but the $\frac{1}{700}$ part, or even a more minute fractional part of phosphorus.

These are trite examples, but they better serve to emphasize the necessity for clear discrimination between things that seem to differ (if at all) but very slightly, and also to remind us to properly qualify and elucidate our statements, and to closely observe the small things.

Dr. G. Gore has shown how widespread and inclusive are the influences of seemingly small causes. Thus, warmth, or even moderate pressure, applied to a piece of steel, definitely and in most cases measurably altered its "length, breadth, thickness, molecular arrangement, atomic distance, specific gravity, cohesive power, adhesion to liquids, elasticity, temperature, specific heat, latent heat, thermic conductivity, thermo-electric power, electric conduction, resistance, magnetic capacity, chemical and chemico-electric actions, and a number of other properties simultaneously," so that his vivid experiments almost produce the impression that this metal is endowed with vitality.

Thus, although we need not pay attention to all these points, you see that if we treat metal as inert, and stable under all except extreme variations of temperature and pressure, we shall be deceived, and find our attempted application of experimental results to daily practice very disappointing; but if we carefully discriminate and notice the small signs, we shall make fewer mistakes, have less failures in daily work, do something to lessen the still wide field of the uncertain, and increase the present narrow swath of the known and certain.

May I now thank you for the kind and considerate attention with which you have listened to this dry prosing. Remember, in extenuation, that it is the nineteenth year you have listened to an address from the chair, and the possibilities of something new and interesting to all seem—at least to me—very limited.

TOPICAL DISCUSSIONS.

Secretary Setchel—There is a question which has been suggested to me by a member, as to the value of substituting a rectangular exhaust tip instead of the round one, as has been adopted, as I understand, by the Pennsylvania Central Railroad. It seems to me that the office of the exhaust, being to displace all of the atmosphere in the stack, and the stack being of a circular form, the best form for an exhaust tip would be that of the stack. And yet, for some reasons, as I have before stated, I believe that the Pennsylvania Railroad have adopted the other form; and if there are any members from that road present, or anyone that can give us an idea of why it is done, or the value of doing it, I should be glad to hear from them.

Mr. Briggs—This is a question in which we are all interested. The grand secret, I believe, is to obtain as near a perfect vacuum in the smoke-box as possible. And I have always looked upon an exhaust tip as what you might term a "pump." The steam,

passing up through the stack, acts like the piston pumping the air out of the smoke-box. And it seems to me that if you have a round orifice to fill, like a stack, that the round nozzle would be the best. It has always been my choice. I cannot see how a rectangular one would be of any greater advantage.

Mr. Johann—My opinion on that matter of exhaust nozzles is that it is simply a matter of expediency. I do not see as there can be any very material difference between a round or a square orifice in an exhaust nozzle. What you want is just what Mr. Briggs explains. You want to expel the atmosphere and create a vacuum, so as to draw your fire, and the question is, what will do that most effectually; and whatever will, that is what you want. Without having made any experiments, and not pretending to speak directly to the facts of the matter, it is my opinion that it does not really make any difference except the matter of convenience. Now, you can manipulate a circular orifice with a great deal less trouble than you can a square one, and for that reason I presume they are made circular; and why some one else makes them square I have not inquired into, and I do not see as there is any particular advantage in that form over the circular. In my opinion what you want with exhaust pipes is to have room enough to get your steam out of your cylinder as rapidly as possible, and to create the proper vacuum for your furnace; and if you do that, that is all you want, and all you can do.

Mr. Forney—I would like to know what difference there would be in the shape of the exhaust when it comes through the round pipe from what it is when it comes through the square. This discussion reminds me of a dispute I once heard as to why certain oils would not lubricate. One man said the reason why his oil not would lubricate was that the ultimate particles were globular; and the other man said that the reason his oil would not lubricate was because the utimate particles were diamond shaped. I do not know who has ever found out what the form of a current of steam is in the chimney after it leaves the exhaust tip. If there is anyone who has done so, I should like to have him give us the result of his experience. I am open to conviction. If anybody has any evidence to submit on this point, I think it would be very well to give it; but it seems to me a discussion from a merely speculative point of view is not likely to lead to any very interesting results.

Mr. Sinclair—I think the draft in the smoke stack is maintained on the same principle that a current is maintained in the injector; and most of you are perfectly familiar with the manipulating of an injector. I think that if Mr. Forney tries an injector with a combining tube of a rectangular section he will find a most decided difference in the amount of steam needed to raise the water. There have been a great many experiments made, at one time and another, to see what form of nozzle and what position of nozzle would produce the best vacuum, and would make steam the easiest; and it has been decidedly shown that a round nozzle, about the diameter of the stack below the stack opening, makes a more perfect vacuum for the size of opening than any other shape. That is not merely an assumption. It is the result of very carefully conducted experiments. And if any of you care to look over the very interesting reports made by Mr. Martin to this Society, some years ago, you will find a great deal that is interesting and edifying on the matter of exhaust nozzles.

E. M. Roberts (Ashland Coal and Mining Company)—Even if we lay aside the question of any advantages of the two, we find often, with straight stacks, that it is a very inconvenient thing to clean them out. On some roads, many engineers have adopted a flat tube with a long handle to it. By inserting that through the top of the stack, and by entering the nozzle, they can clean the nozzles out and jog along in a few minutes. If it had no other advantage than that, I certainly think the round nozzle is worth keeping.

Mr. Howison (Cumberland & Penn)—I have used almost every shape of nozzle. I have found the same results from the round nozzle as from any other, and I do not see why the round nozzle isn't about the thing that we want. I would state that I have used the square nozzle and the round. I think that any one who is interested in the matter, if they should go to my scrap pile, could see the square nozzle there now. I can find no difference at all between the square and the round dome. The round one gives equally as good results in my estimation.

Mr. Forney—I do not wish to be understood by this audience as meaning to throw the question over hastily. I should be very ready to listen to any argument tending to show the superiority of either round or square nozzles. If Mr. Sinclair has any evidence to submit in relation to this matter, I think it is very important that we should have it. The gentlemen who has just spoken has referred to the square nozzle. Those nozzles were put on engines when I was an apprentice, and I might say that I was raised on the square nozzles, but up to this time I have never heard any reason why there was any superiority of the square nozzle over the round. A gentleman near me says that on the Pennsylvania road they use the square nozzle because they can be brought nearer the center of the smoke-stack. That may be a reason, but there may be other reasons.

L. M. Ames—I will state that I have been on a division of the Pennsylvania Railroad, until recently, for about twelve years past, and we have been using square and round nozzles on about half of our engines each. We have about fifty engines on the division. My experience with those nozzles is that one is as good as the other. We use them both, and both make steam about alike. That is on the Northern Central Division.

Mr. Setchel—I just wanted to touch on a point that has not been mentioned yet, and it has been given to me as a reason why the Pennsylvania road uses that kind of a nozzle. I think it does not apply with equal force now as it did a great many years ago. But there was a time when engineers were allowed a great deal of latitude about what they should do. Every man had his own engine. That engine ran when he could run it, and if he could not run it, if he could pick out some fellow to run her, then she would run; if not, some other engine was substituted. They had their pet smoke-stack, and pet everything about the engine, and they thought as much of her probably as some men do of their wives. But that day is passed. At that period I have been told, in a joking way, of course, that they put in a square nozzle so that the engineers could not as readily measure the size of it and want to change it.

Mr. Johann—I should like to hear from some members their views and opinions on a single and double nozzle. Some members use the single nozzle, and think they are the best thing in the world; other members use the double nozzle and think they are the best thing in the world. I am not prepared to enter into any argument about the matter, for I have not made any practical experiments on the subject to know which is the best. And while we are on this subject I thought we might just as well have this branch of it elucidated somehow. If any members have any experience or facts in regard to the matter I should be very glad to hear them.

Mr. Briggs—I think that Mr. Martin, in Chili, published a long series of articles in the papers, wherein he demonstrated the fact that a double nozzle was of much greater advantage to an engine than a single nozzle. I read the articles at the time they were published, and acted on his experience. Yet, at the same time, I would like to hear the experience of our members in reference to it.

Mr. Sinclair—If my memory serves me right, Mr. Martin was in Peru at the time he wrote those articles. He was a member of this Association; and it was to this Association that the articles were contributed. They were contributed in the form of a report, and a very interesting and valuable report it was, perhaps the most thorough report ever made on this subject, and the most thorough and best conducted experiments ever made in this matter. He went fully into the use of double, single and various forms of nozzles, and these results are given in the fourteenth report, if I mistake not. He was most decidedly in favor of the single nozzle.

Wm. Woodcock (Philadelphia & Reading)—I think that I presented that report of Mr. Martin, and that it was accompanied with lists and data from careful experiments, and I thought at the time that there was a very good series of illustrations of the exhaust nozzle. And the conclusion at which he arrived was that the "compound" nozzle, as he termed it, was the best; that was, a double nozzle running up into about six inches of the top and then putting a round nozzle on to that. From the data furnished I think you will find that the best results were arrived at from the use of that nozzle, and Mr. Boon afterwards conducted experiments with that style of nozzle.

Charles Blackwell (Union Pacific)—I have heard a great many men find fault with a single nozzle. I think that in most cases the complaint is well grounded, it lying in the shape of the nozzle. I have made a good many experiments with single and double nozzles, and one of the first experiments I made with single nozzle gave very disastrous results. I found that the hold-back pressure could be removed by making the two openings, which came from each cylinder at the point of junction, with the single pipe not larger, or materially larger, than the tip of the nozzle. If you have the area where the two pipes join each equivalent to 5 inches in diameter, and the tip 4½ inches, you will have a certain amount of back pressure. If you use a tip 4 inches in diameter, you will have more back pressure. I found that the best way to get rid of the back pressure was to make each of the openings from the two steam pipes, where they join together, as near as possible the diameter of the tip.

Mr. John Campbell (Lehigh Valley)—Will the gentleman please tell us what the size was, both of the double and the single nozzles?

Mr. Blackwell—The experiments which I made were taken with consolidation engines; and to the best of my recollection the nozzle was 4½ or 4¾ inches diameter, in the single nozzle; and each of the two pipes, where they joined the single pipe, was equivalent to that same diameter—4½ or 4¾ inches. The lower casting was, if I recollect right, made so that, in case you wanted to use a large tip you could bore it out larger. I am not quite clear on this point however. The castings were made in such a way that by boring out or bushing, as the case might be, you could make use of the casting. I had very satisfactory results in getting rid of the back pressure—reducing from 23 pounds down to practically nothing.

Mr. Briggs—What was the size of the cylinder with which you experimented?

Mr. Blackwell—20 by 24. I think that the very best results were obtained by lowering the nozzle until it was 36 inches below the top of the smoke-box. I could use then, the 4¾ inch nozzle and get all the steam I wanted. That I could not do, unless with a 4½ inch nozzle, if it was at the ordinary height below the top of the smoke-box—18 or 20 inches; but by lowering the height of that nozzle, I was able to get as much steam with an increased diameter of a quarter of an inch, or 4¾ inches diameter.

Mr. Campbell—I should like to hear a little discussion on the check valve. I saw something new on a road up here recently; the valve was placed inside the boiler. I want to hear some discussion in regard to that valve. I am quite familiar with the ordinary check. This is something new; it goes on the inside of the boiler; I have never seen it before. Perhaps some of the members here can tell something about it. I am told that it is adopted on the Pennsylvania Central Railroad.

Mr. Ames—I will state that the check valve on the inside of the boiler has been but recently adopted on the Pennsylvania road, and that, on talking with three or four master mechanics, I find they do not speak very well of it. I do not think it has been tried long enough to enable anybody to say very much ither for or against it.

Mr. Forney—I do not know whether the members will recollect that at the meeting of this association held in Providence some years ago I had the honor to submit a paper to the association on this subject of checks and of perforations in boilers in various ways. The check which is referred to here, I presume is one with which Mr. Hayward, of Jersey City, had something to do. It is placed inside the boiler, and is arranged in such a way that in the case of accident, or the knocking off of what projects outside of the boiler, the hot water and the steam will not be permitted to escape. I think the members will recollect a very bad accident which occurred near Pittsburgh, in which the check valve was knocked off, and where seven persons in the car were scalded to death on account of the escape of the hot water and the steam from the boiler into the car. This was an accident, I think, where a locomotive crashed into the rear car of a train just in advance. I think it was with a recollection of that accident that the Pennsylvania Railroad authorities have been induced to give this new check valve a test. I was induced to speak again on this matter by motives of humanity. I suppose the members of this association have no idea of the number of perfectly horrible accidents which occur from the scalding of persons in cases of collision. Some time ago I took the pains to collect all which I could from the newspapers, and the details of some of them are so perfectly horrible that it seems as though this association should give the matter especial attention. The evil grows out of the fact that in the construction of locomotives you fill them up full of holes and then screw some sort of a projection into them, so that they finally resemble a porcupine. In cases of accident, some of these are almost certain to be knocked off, and the hot water and steam escape and scald the persons in the wreck. Whatever can be done to remedy this thing ought to be done. There is certainly nobody in this country to whom these things appeal more forcibly than they do to the master mechanics of this land.

Mr Blackwell—It seems to me that the mode adopted by Mr. Webb, of the London and Northwestern Railway, in England, gets over, to a very great extent, the difficulty referred to by Mr. Forney, especially in connection with cases where the check valve is broken off. I presume that many here have seen the drawings showing that Mr. Webb introduces feed-water by means of checks attached on the back head The water is carried from these checks forward by means of a tube, and thereby he overcomes the necessity of mud or scales near the pipe. This plan of attachment reduces the danger referred to very greatly.

It is said that the Shah of Persia has granted such concessions as make the construction of several railroads probable.

It appears that in China the determination to construct one or more railroads has been reconsidered, and the matter indefinitely postponed.

Congress is flooded with petitions for the free manufacture of oleomargarine, on the ground that any tax, fine or restraint imposed upon the stuff will make real butter too expensive for the poor man. It is only a wonder that Congress isn't petitioned to repeal all the laws against the manufacture and circulation of counterfeit money, for the reason that the competition of the cheap counterfeit would make real money cheaper for the poor man. In these days, every time a demagogue or any other kind of a rascal thinks of a new swindle, he advertises it in the name of "the poor man." The poor man needs to go a gunning after the fellows who are taking his name in vain.—*Burdette in Brooklyn Eagle.*

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PUBLISHED WEEKLY

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American Machinist Publishing Co.

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JACKSON BAILEY, Vice-Pres't.
LYCURGUS B. MOORE, Treas. and Sec'y.
96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.
The International News Company,
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NEW YORK, JULY 3, 1886.

CONTENTS.

	PAGE
The Morton-Poole Calender Roll Grinding Lathe By Joshua Rose	1
Early Engineering Reminiscences. By George Escol Sellers	2
Improved Scroll Saw	3
Report of Railway Master Mechanics on Shop Tools and Machinery	3
Simplifying Machines	4
Schuhmann's Automatic Cut-Off Engine	4
Abstracts of Topical Discussions and of Papers at the Chicago Meeting of the Mechanical Engineers	5
One Cause of Fire from Smoke-Stacks. By Robert E. Masters	5
Letters from Practical Men—Locomotive Firing and Management	5
Convention of Railway Master Mechanics	6, 7
Education for Mechanics and Engineers	8
Sinking Wells in the Southwest	8
An Ohio Centennial Exposition	8
David Van Nostrand	8
Literary Notes	9
Questions and Answers	9
Business Specials	9
Manufactures	9
Machinists' Supplies and Iron	10

Education for Mechanics and Engineers.

The increasing interest everywhere in manual training schools and in technical schools in which workshop practice is made prominent, is a good sign. It shows that the tendency is towards better training for mechanics, which is what is needed. Some of the ideas of the advocates of such schools are likely to prove visionary; all that they anticipate and claim will not be accomplished, but a large amount of good will be realized. Their number cannot be too great, within reasonable limits.

This qualification may be necessary, because if they become too numerous they may cease to be profitable, then they are likely to fall below what they should be, and their number will be a positive disadvantage.

In these schools many young men not likely to work up through the shop will learn something of a trade that may in the end be useful to them; at the same time they will get a knowledge of books that the man who comes up through the shop is likely to be deficient in. Not that he need be, but because he will probably neglect what he does not see immediate need of.

It is unfortunate that there is in any sense a conflict between mechanics, or engineers if they prefer to be called so, who have pursued different methods to acquire necessary knowledge. The question is purely one of competency, and that will be settled by what they do and not by what they claim. This difference of opinion is pretty certain to crop out whenever any discussion touching the question comes up, as at the Chicago meeting of mechanical engineers. It is in the main unprofitable, inasmuch as it settles nothing. In the meantime technical schools and the shop are constantly getting nearer together. In the former the necessity for more of manual training is coming to be recognized, and provided for. We hear more of technical schools branching out in the direction of increased workshop facilities than in any other direction. For those who take the shop course, as the majority will continue to do, evening schools are established where instruction in matters in the line of mechanics and mechanical engineering is given. These are becoming common in all large manufacturing towns, and are doing a most excellent work. There is no fear of such schools becoming too numerous, because there is in connection with them no intention of money making.

As between the technical or manual training-school course and the shop course, there is something to be said in favor of both. Many things may be learned in the shop that will never be learned in the school; in fact, the school course must be supplemented with a good deal of shop practice to be of much use in turning out mechanics. On the other hand, the advantage, so far as theoretical knowledge is concerned, is with the school. Men may work up to be good mechanics or mechanical engineers through either, and which will be the best course for a young man is a matter of temperament and inclination largely. If some driving is necessary to induce a young man to study books, he will probably get the most of what he needs at school; if his inclination is more towards reading and study than towards practice, the shop ought to be the best for him.

With all the advantages of the school, and they are many, young men whose preferences or necessities lead them to the shop have nothing to fear if they realize that it is all-important that they study hard in the line of what they propose to work up to through the trade they are learning, and to that end make systematic use of a good deal of their leisure time. It is almost entirely a matter of industry and determination. With these the shopman will find plenty of means for the necessary study—it may be partly through assistance at evening schools, or it may be without any assistance of the kind. Without this industry and determination, he would no more succeed at school than in the shop.

There is absolutely no occasion for quarreling over education for mechanics or mechanical engineers. No one cares about methods; results alone are important. Yet all the disagreement is as to methods. Men have come up to eminence as mechanics through schools; they will continue to do so. Men have come up to at least equal eminence through the workshop, and will continue to do so. Success is a question of hard work and some aptness, or at least a hearty liking for the business in either case. Quarreling over methods is idle and mischievous.

There is one other point in the controversy that is not well taken. That is that a young man after spending ten hours in a shop is in no condition for study. This is not true. It is almost universally conceded in educational matters that a certain amount of muscular effort is essential to health and to school progress. Dyspeptic students do not succeed. It is just about as true that mental dyspeptics do not succeed as well in learning a trade, or working at it, as those who are healthy in this respect. A moderate amount of good hard brain work is as essential to the man who works mostly with his hands as physical exercise is to the one who bends over books.

Technical schools will in the future do good work in two ways: They will afford means of education, both theoretical and practical, to a good many young men, and they will show the importance of self-education to a good many more. It is beyond question that in the future more than in the past mechanics will find a knowledge of books essential. This change will be largely due to the influence of technical schools. It is equally true that hereafter more book knowledge of technical matters will not be of much value, and this will be due to the fact that shopmen generally will acquire this knowledge.

The passage by Congress of the bill permitting the Baltimore and Ohio Railroad to build a bridge across the Kill von Kull brings to mind with what persistency one railroad, having the right of entry to an important city, will endeavor to prevent others obtaining the same privilege. The Baltimore and Ohio has been opposed in every possible way from entering New York, and in this opposition there has been nothing brought out to show that the public was to be injured by such entry. On the contrary, the plans adopted appear to be substantially unobjectionable, and it looks to disinterested observers that the extension of the Baltimore and Ohio to this city would be to the advantage of the people. But it would be, presumably, to the disadvantage of stockholders in other roads, hence the fight against it. There may be other reasons, but they have not been made apparent. It has looked all along as if the wants and interests of the public were not to be considered in the matter, or that they were to be opposed by a few men who were interested in keeping down fair competition. Opposition of this sort is constant somewhere, but it is a dog-in-the-manger policy that seldom succeeds. In the end the result is that the opposed road gets what it wants, and a good deal of sympathy besides. If such opposition was always or generally in the interest of the public, it would succeed, but it is almost always so clearly against this, that it is taken for granted that when one road opposes the extension of another the right ought to be granted as a matter of general welfare.

Just why railroads should oppose others in this way any more than that merchants should try by force to keep others out of business, or that manufacturers should oppose additions to their number is not clear. A good deal of money is spent for this purpose, which calls for similar or larger expenditure from the other side to the controversy, then in the end the good-natured public foot the bills, paying for the corruption of their legislators as a matter of course.

We hope that Mr. Giddings, a brief account of whose experiments, as presented before the Society of Mechanical Engineers, we gave in a recent issue, will continue his investigations in the direction of determining the power absorbed in operating the valves of steam engines; also that others will be induced to experiment in the same direction. This is one of the points in steam engineering upon which more light would be a decided advantage, and one upon which there is much difference of opinion. Some years ago Mr. Thomas Adams, of England, made experiments with a view to determining the power required to operate the valves of locomotive engines, but for some reason but little confidence was had in the conclusions he came to. We have not the data at hand, but remember that he made out that a percentage of the total power was used up in this way that seemed at the time enormous. The probable gain by using balanced valves, or some other than flat slide valves, could be to some extent calculated if the exact power required to keep them in motion was known.

Will some of our readers who know the English practice for diameters and pitches, also form and taper of threads on wrought iron pipe, especially for sizes 2″ and upwards, please send us the particulars?

Sinking Wells in the Southwest.

A number of Texas cattle raisers are about to do what should long since have been done in that region on a far larger scale, namely, they are about to sink a large number of wells, at regular intervals, along the vast pastures that stretch across the State to the Rio Grande.

It is amazing that the land grant railroads in the arid regions of the Southwest, to whom a benevolent national or state government has given millions of acres of land as practically a free gift, have not long since recognized the advantage to them of sinking the driven or artesian wells, that alone are needed to ensure continued fertility to the immense tracts of land controlled by them. That very many such wells could be successfully opened, and at a comparatively small cost, there is little doubt. That they would add enormously, in the course of a few years, to the value of the lands around them, and to the traffic of the railroads, by opening extensive regions to rapid settlement, is equally certain.

An Ohio Centennial Exposition.

An Ohio Centennial Exposition, commemorating the one hundredth anniversary of the settlement of that State, is to be held at Columbus, the State capital, during the whole of the month of September, 1888, on the grounds and in the buildings owned and controlled by the State Board of Agriculture. By this arrangement a large expense for buildings and other necessary accommodations will be obviated. The main building will have a floor space of over 100,000 square feet, and "Power Hall" will have 1,500 square feet, with ample power and shafting for the display of all machinery.

Every department of the State's progress is to be represented. The machinery industries of the State are sufficient in themselves to make a good display, if fully represented. We hope it will be in full accord with the prevailing "Ohio idea" to have them well represented on that occasion. As the population of at least a dozen States has been largely recruited through the exodus of restless Buckeyes, it is likely that a very large number of these individuals will thriftily conclude to re-visit their native soil and "take in" the new centennial on the way.

David Van Nostrand.

The death of David Van Nostrand, of New York, removes one who has during many years rendered substantial service to the reading public as a publisher of mechanical and scientific books. The veteran publisher died aged 75 years. A number of useful books have been published by his firm, while through his means *Van Nostrand's Engineering Magazine*, a monthly periodical of limited circulation but of excellent standing, has made a great deal of useful technical information accessible to engineers, in authoritative shape. His has been a useful and a busy life, and his death will be felt by many, who never saw his face, as the death of a familiar friend.

Alexander Gordon, of the Niles Tool Works and Gordon & Maxwell Companies, Hamilton, Ohio, is booked to sail for Europe with his family on June 23rd in the steamer City of Rome. We understand Mr. Gordon's trip is for pleasure and rest combined. We wish him plenty of both, and a safe return.

Literary Notes.

KEY TO THE TEXT-BOOK ON THE MECHANics of Materials, and of Bearers, Columns and Shafts. By Mansfield Merriam, Prof. of Civil Engineering in Lehigh University, New York: John Wiley & Sons, 15 Astor Place.

The author, in his preface, so fully outlines the object of his Key, that we copy it as follows:

The following pages, containing the answers to the problems in the Text-Book on Mechanics of Materials, and of Beams, Columns and Shafts, are here published in response to inquiries from several who have used the book. The opportunity has also been taken to give an outline of the method of solution of a few of the more difficult problems, and to correct some typographical errors which appear in the text.

The unit-stresses used for the solution of problems have been uniformly taken from the table in Art. 52. Considering the great variation in these data, it has not been thought best to carry numerical answers to more than three significant figures; thus, if the strict solution of a problem from the given data should give 43,682 lbs. as the answer, it is here stated as 43,700 lbs.

On pages 15 and 16 will be found an investigation concerning the internal work in a beam, which furnishes, for certain cases, a new method of deducing the formulæ for deflection without the use of the elastic curve.

THE NEW YORK AND NEW JERSEY MANUFACTURERS AND STEAM USERS' BUSINESS DIRECTORY, arranged by city and town, alphabetically, containing names, business location and number of boilers used in each establishment. Price $6. The J. N. Mills Publishing Company, 30 Vesey street, New York.

This directory is a large volume, neatly bound in cloth. It is systematically made up with a great deal of labor and research, and will prove particularly valuable to all who have business with the owners of steam boilers and engines. It gives the exact location of every establishment using boilers, and the character of the business. In looking over the pages, an observer will notice that boilers are used in almost every kind of commercial business that can be named.

By a typographical error we gave the subscription price of the *Official Gazette of the U. S. Pat nt Office* as $3 a year. It is $5 a year. There are four volumes a year. Every subscription must commence with the beginning of a volume. No subscription is taken for less than three months. Address the U. S. Patent Office, Washington, D. C.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(255) J. P. G., Vineland, N. J., writes: I want to stain beech wood black, without checking it, and have the stain penetrate the wood deep enough to finish, say 1-64th part of an inch. The articles are small—handles, knobs, etc. I have tried sulphate of iron and logwood; vinegar, iron and logwood. The surface shows up all right, but the color does not penetrate, unless boiled, which checks the wood. *A.*—A similar difficulty has been overcome by forming a partial vacuum in a close vessel containing wood to be stained and dye used. Some of the air being exhausted from the pores of the wood the dye was drawn into the wood, when the vacuum was removed, or air was let into the vessel.

(256) C. A. R., Higginsville, Me., writes: I use a No. 8 Blakeley's jet to draw water from pond, distant 125 yards. The pond is now dry. There is another pond 510 yards from engine house. From this pond there is a gradual rise of 20 feet in the first 110 yards. For the other 400 yards it is down grade, except about 6 feet rise between engine house and old pond. The jet is—steam pipe ⅜"; discharge, ¾"; suction, 1". The question is, can I draw water from the second-named pond under the conditions as given? *A.*—It is possible that you can, but we should say that it was extremely doubtful. If we were to try it we should use at least one size larger pipe than you now use. Take good pains to have it tight, and put a foot valve at the pond. Then, by filling the pipe with water before starting, you *may* succeed.

(257) F. E. W., Cleveland, Ohio, writes: Which is the best way of hardening and tempering milling cutters for milling reamers and taps, so as to get the cutting edge hard and durable, and how to keep them from cracking in cooling? *A.*—Heat the cutter in a red-hot lead bath. The teeth will become hot, and may be hardened by plunging the cutter into water before the body of the cutter has become hot enough to harden. This method will work well with some forms of cutters, but in some peculiar shapes the heating and cooling will cause strains, which may cause cracking. 2. Is there any book published which treats on tempering? *A.*—There are several books in print which tell how tempering is done, but there is not a book printed from which alone a man can learn to temper steel. The book may help, but the matter must be learned by practice and experience.

(258) E. E. B., Kenosha, Wis., asks: Can you inform me in regard to making soda engine boilers, how they work, and the amount of chemicals used? *A.*—The only soda motor we know of in this country was brought from Germany, to run on the Minneapolis, Lyndale & Minnetonka R. R., where it has been tried. You might obtain particulars by writing to the company in Minneapolis, Minn. Caustic soda is the only chemical used. It is charged into the lower part of the boiler at a high temperature. The upper part of the boiler contains water. A number of tubes, capped at the lower ends, extend from the water portion into the hot soda. Steam thereby generated is passed through the soda by means of a coiled pipe, perforated so as to allow the soda to absorb all the moisture. Any ordinary steam engine can be used, and there is said to be no exhaust. One charge of soda lasts four or five hours, under favorable conditions. Then it is taken out, the water in it evaporated by means of boiling, and the soda used again.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Patent Att'y, H. W. T. Jenner, Washington, D. C.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Veneer machines, with latest improvements, Farrel F'dy & Mach. Co., Ansonia, Ct. Send for circular.

Tack, Wire and Shoe Nail Machinery. Wm. A. Sweetser, Brockton, Mass.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

"Modern Steam Engines," $6; "Mechanical Drawing Self-Taught," $4 Joshua Rose, Box 3306, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Improved Labor-saving Upright Drills, 20-in. to 36-in., inclusive. Currier & Snyder, Worcester, Mass.

Curtis Pressure Regulators, Curtis Return Trap. Curtis Damper Regulator. See June 19, p. 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

"Morrison's Practical Engineer." A complete treatise (200 pp.) on steam and general mach. Mailed on receipt of $1. W. A. Morrison, Box 373, Lowell, Mass

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

Bound Volumes of the AMERICAN MACHINIST for the years 1880, 1881, 1882, 1883, 1884 and 1885. These volumes are strongly bound in cloth, and will wear well. Price $3.50 each; express charges additional. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Hints to Steam Users." A carefully prepared book on the care and management of steam boilers. Especially valuable to owners, engineers and firemen. Contains useful information, tables, rules, etc., etc. It is the best book ever issued for the price. Send 25 cts. in stamps to Steam Users Publishing Co., 30 Vesey street, N. Y.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

Manufactures

It is rumored that locomotive works are to be built at or near Birmingham, Ala.

It is reported that the Texas and St. Louis Railroad will build $100,000 machine shops at Pine Bluff, Ark.

Williams & Bayton, of Cleveland, Ohio, will erect a new nail factory at Canonsburg, Pa.

Chas. De H. Brewer, 10 Wall st., New York, will erect a five-story brick factory, to cost $40,000.

It is rumored that the foundry of E. R. Allen & Co, at Whitesville, is to be removed to Olean, N. Y.

$15,000 has been subscribed by the Furniture Workers' Union, Baltimore, towards starting a furniture factory.

Matthew Wiard & Co. have started a foundry at 118 Hope street, Brooklyn, N. Y., with the intention to make fine castings.

M. B. Neeley, Rockbridge, Ky., has made a proposition to Pulaski, Tenn., to erect a large flouring mill at that place.

The Goodyear Rubber Co., of which ex-Governor English is president, will erect a new factory in Naugatuck, Conn.

There is talk of turning the Old Colony Shovel Works at East Taunton, Mass., into a concern for rolling steel rails.

James Brandon, 233 Tenth avenue, New York, proposes to start a shop for the manufacture of his piston-ring packing.

Zebedee Ford, of Smithfield, Ohio, contemplates starting an establishment for the manufacture of agricultural implements.

A new freight locomotive, with cylinders 20'x26", will soon be finished at the Boston and Albany Railroad shops, Springfield, Mass.

Johnson & Bassett, Worcester, Mass., manufacturers of woolen machinery, are erecting a 5-story shop building 125x62 feet.

It is reported that Stephen Morris & Son, 121 N. Sixth street, Philadelphia, will erect a stove foundry at North Wales, Pa., in the near future.

The Joseph Dixon Crucible Co., Jersey City, N. J., have manufactured and sold an average of 110,000 lead pencils for each day of the present year, so far.

E. A. Walker, 75 Laurel street, Philadelphia, has issued a new circular descriptive of the Richards combination planer and shaper manufactured by him.

The Oneida (N. Y.) Foundry and Machine Co. are running twelve hours a day. Business is good with them, the Oneida improved chucks being in active demand.

J. P. Witherow, of Pittsburgh, Pa., has received the contract to build the 100-ton iron furnace for the Sheffield, Ala. It is said that work will be begun at once.

The McQueen Locomotive Works, Schenectady, N. Y., sold for $45,000. The Edison Electric Light Co. are expected to put 400 men to work in the buildings.

Field, Thayer & Co., Boston, Mass., are building two five-story buildings in Haverhill, Mass., to be used as a shoe factory. The buildings are 80x50 and 70x45 feet, respectively.

The Pittsburgh (Pa.) Forge and Iron Works have recently been started on double time. Their daily output is more than 75 tons of wrought work, used in building cars.

The Athens Woolen Mills, Athens, Tenn., is a new corporation, which will soon proceed to erect a mill 430x60 feet. W. M. Nixon is president, and R. J. Fisher secretary and treasurer.

Wm. E. Barrows, formerly president of the Willimantic Linen Company, of Willimantic, Conn., has assumed the duties of general manager of the Dickson Manufacturing Company, of Scranton.

The Triple Thermic Motor Co., of Lowell, has made a change in its officers. We have not heard of any change in the motor lately. There are many who do not believe that the motor will mote.

The W. F. Washburn Brass and Iron Works, of Yonkers, N. Y., formerly W. F. Washburn, has been incorporated. Capital stock, $30,000. Wilbur F. Washburn, Geo. W. Farnam, and Oscar Waring, corporators.

The Grand Trunk shops at Fort Gratiot, Mich. are now being more extensively operated than for some time past, and employment will be given to nearly 100 extra men. All the discharged hands have had an opportunity to resume work.

Ground has been broken at Uniontown, Pa., for the erection of a large rolling mill, to cover an area of 44,224 square feet, with engine house 48x125 feet, and boiler house 36x135 feet. H. P. Butts and W. R. Yeager are interested.

The Mosler Safe and Lock Co., Cincinnati, Ohio are running at full capacity, and have been forced to make large additions to their present plant. Plans and specifications are now out for a four-story addition to their works.

The Excelsior Foundry and Machine Shop has been incorporated at Birmingham, Ala., and are building a 35x75 foot shop. They will do a general machine business; also manufacture Jones' car wheels and axles.

Westborough Mass., has a Business Mens' Association, with J. A. Trowbridge as president. One of the schemes on hand is the building of a boot shop, 38x200 feet, four stories, for Gould & Walker, at a cost of $20,000.

Oscar Simmons, brother of the senior partner of W. A. Simmons & Co., agents for the Peerless Automatic Damper Regulator, has just opened an office at 22 & 24 Fourth street, Philadelphia, for the sale of those damper regulators.

The Lebanon Mfg. Co., Lebanon, Pa., will convert their old foundry into a machine shop, which will be equipped with a large lathe, iron planer and boring mill, so that the works will be able to do all kinds of heavy work. A new foundry, 203x60 feet, will be erected.

The Knights of Labor Machine and Boiler Co. has been incorporated at Portsmouth, Va., with C. R. Warren as president; John A. McDonald, vice-president; William A. Jobson, secretary, and John C. Kaufman, treasurer. The capital stock is not to exceed $100,000.

T. B. Twombly, General Master Mechanic of the Chicago, Rock Island and Pacific Railway shops at Chicago, has in hand a draft of specifications for new locomotives. It is probable the road may contract for the building of 50 locomotives during the year.

The Brady Mfg. Co., Brooklyn, N.Y., are employing 100 men on both contract and day work. No trouble has occurred at this place on account of the recent labor movement. It is stated that the men in this shop represent themselves, individually, to be non-union men.

A Government board of three engineers have reported to the commandant of the Norfolk Navy Yard that they tested the Eureka packing, illustrated in our October 18, 1884, issue, in one of the piston-rod stuffing-boxes of the main engine of the U. S. tug Nina, where it stood 65 days without showing any leakage, before requiring to have the glands set up.

The *Northwestern Miller*, in reviewing the situation at the Minneapolis flour mills, says: "Heavy as were the flour exports of our mills for April, those of May exceeded them by over 30,000 barrels, and were undoubtedly never equaled before. In amount the exports for May were 297,900 barrels, including several thousand shipped to Canada, against 264,800 barrels for April, and 233,800 barrels for March.

The Damascus Bronze Co., of Pittsburgh, are building a new foundry, 50x120 feet, in Allegheny, in order to meet the growing demand for Damascus bronze. The foundry will be ready for occupation about July 1st, and the company's office will be in the Lewis block. In the new foundry natural gas will be used, and this will be the first establishment in Pittsburgh, or in the United States, to use this fuel in journal-bearing metal.

The *Iron Trade Review* says: "One of the most important contracts for astronomical work ever taken in this country has just been awarded to Messrs. Warner & Swasey, of Cleveland, being the telescope and dome for the new Lick Observatory in California. The tube is to be 60' long and 40', diameter. From the floor to the center of motion the distance is 35'. The base is 17'x17'; polar axis 12" diameter; weight of mounting, 25 tons. It will require about a year and a-half in construction.

A company has been formed at New Castle, Pa. for the purpose of manufacturing steel-wire nails. The capital of the company is unrestricted, and represents the wealthiest men in New Castle. Jno. Stevenson, Jr., is the president and manager, J. H. P. Cunningham is the treasurer, and Rufus C. Patterson is the Secretary. The company have purchased 1¼ acres of ground, and will erect brick buildings with a frontage of 150 feet, and length of 450 feet. They will employ at the start about 80 hands.

The Dickson Manufacturing Co. have some 20 engines under way, and, like all other builders could do more, yet are fairly well satisfied with present condition of business and the outlook for the future. The demand for the Dickson steel wheel is so rapidly growing that an enlarged plant will be a probable necessity in the near future. They have just completed shipment for eight cars to the Erie, some sixteen to the Delaware & Hudson, and several sets for the Fitchburg and Philadelphia & Reading.—*Railway Age.*

The *Baltimore Manufacturers' Record* says; "There seems to be no scarcity of money in the South for investment in manufacturing enterprises where there are good prospects for success. In Athens, Tenn., a new woolen manufacturing company was organized last week to build a mill 40x400 feet. So freely was the stock taken by Athens business men that double the amount of capital required could have been secured, $5,000 in one block offered for stock having been refused."

The Gardner Governor Works, Quincy, Ill., are full of orders. Among recent shipments were one 9" governor to the Hartman Steel Co., Beaver Falls, Pa.; one 9" governor and angle valve to the St. Louis Iron and Machine Works, St. Louis; one each 8", 7", and 5" finely finished governors, with angle valves, to the Smith, Beggs & Rankin Machine Co., St. Louis; also forty 3¼" governors to the J. P. Ford & Co. Plate Glass Works, Tarentum, Pa., which is probably the largest order for governors ever placed in this country for the sole use of one concern. They report their gross sales as 50 per cent. greater for the first five months of this year than for the corresponding period of last year.

The new catalogue of the Fond Engineering Co., of St. Louis, contains over 100 pages, closely printed and fully illustrated with improved types of steam and hydraulic machinery, including engines, boilers, furnaces, grates, pumps, pumping engines, blowing engines, air compressors, air pumps, condensing apparatus, injectors, feed-water heaters, steam gauges, etc. The catalogue also contains a list of proportions, heating surface and horse-powers of standard horizontal boilers, a table of approximate horse-power of chimneys, and several other tables that engineers will appreciate.

Machinists' Supplies and Iron.

NEW YORK, June 17, 1886.

The outlook remains about the same as last week.

Iron—In American Pig, consumers buy only for present needs to cover current requirements, but considerable product is absorbed by contract deliveries. We quote Standard Lehigh and North River brands $18 to $18.50 for No. 1 X; $17 to $17.50 for No. 2: and $16 to $16.50 for Forge.

Scotch Pig—Moderate demand; no new feature. We quote Coltness, $20; Glengarnock, $19; Gartsherrie, $19.50; Summerlee, $19.50; Eglinton $17.50 to $18; Langloan, $19.50, and Dalmellington, $18.50.

Tin—Another advance is noted. Banca, 23½c.; Straits and Malaca, 23¾c.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Mech. engineer and draftsman, competent practically and theoretically, desires engagement in works or drafting room. Address W. S., 9 Bickerdike st., Chicago, Ill.

Wanted—A situation as head draftsman, or ass't supt., by man of experience as such; technical education; best of references. Address M. Thomas, AM. MACHINIST.

Wanted—To correspond with some party requiring a No. 1 toolsmith; first-class hand to handle and temper valuable steel tools; steady, sober, industrious; moderate pay. Address J. W. M., 160 Wells st., Chicago, Ill.

Wanted—Situation by a first-class pattern-maker and draftsman; 26 years' experience in engines and general machinery; 12 years as foreman and manager; age, 40; married; good references. Address Patterns AM. MACHINIST.

A first-class mechanical engineer and draftsman, with large experience in printing machinery, here and abroad, desires engagement as superintendent of works, or as head draftsman. Address S. M. H., AM. MACHINIST.

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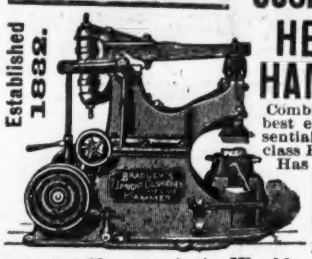

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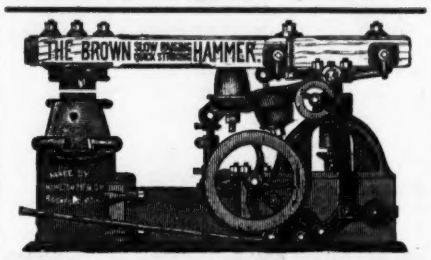

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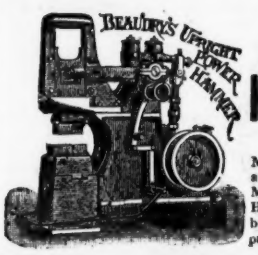

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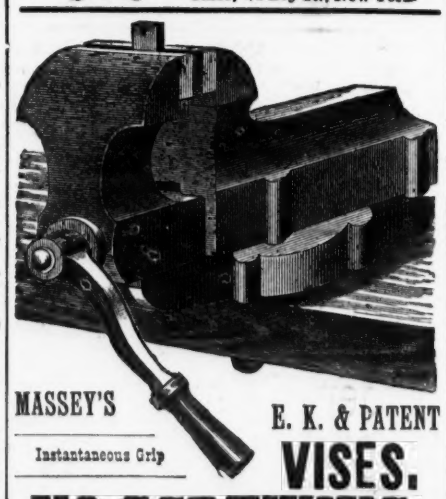

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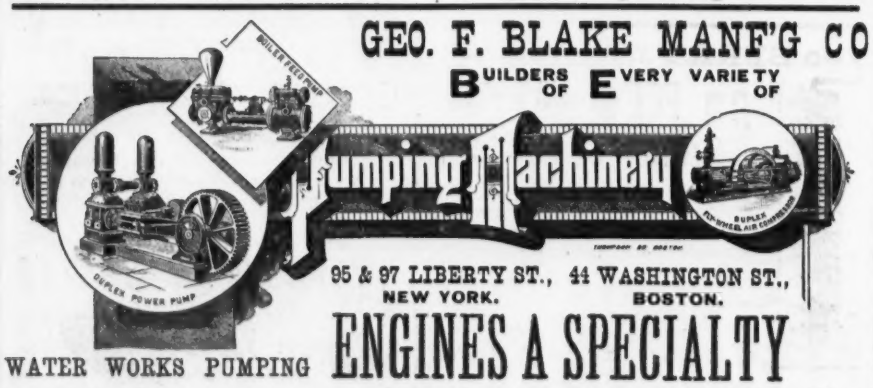

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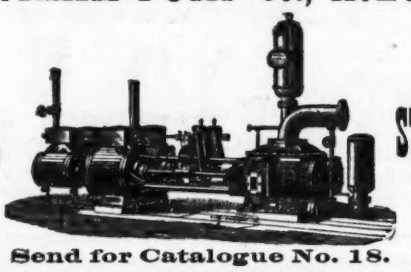

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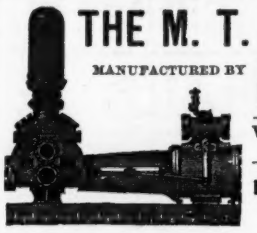

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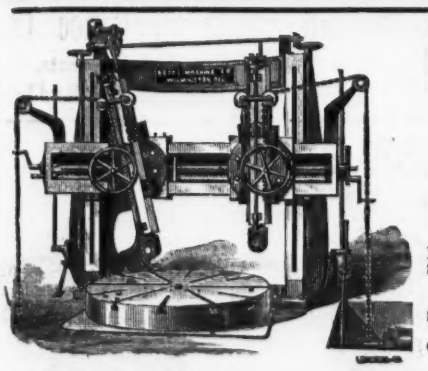

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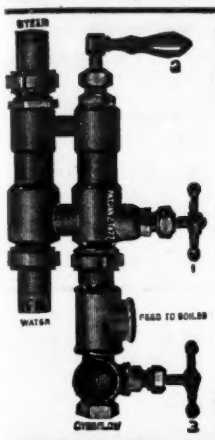

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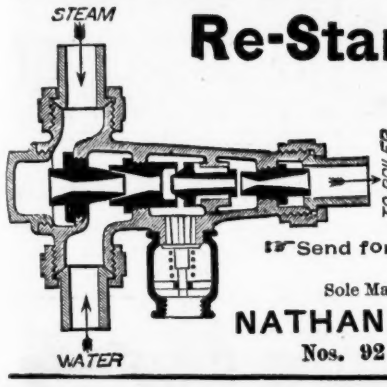

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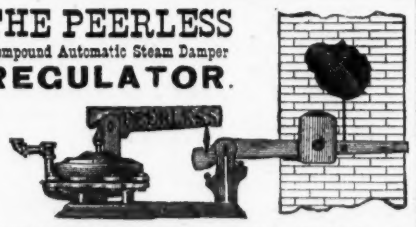

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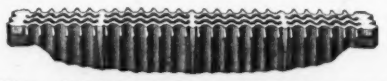

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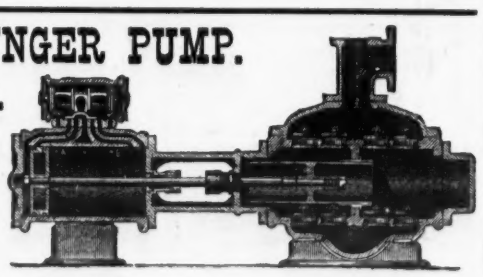

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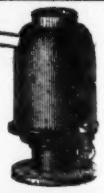

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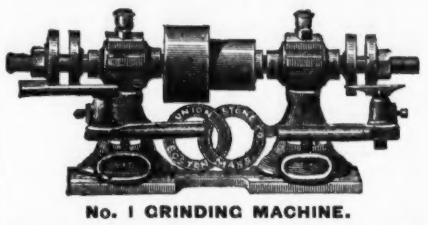

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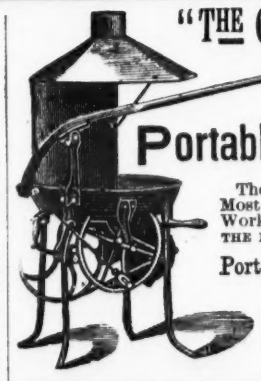

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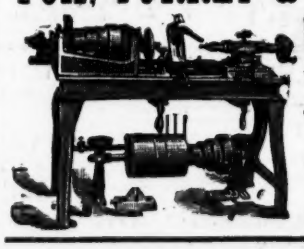

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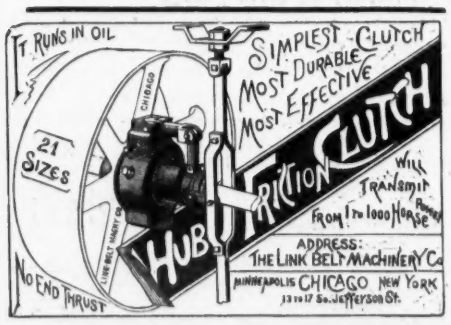

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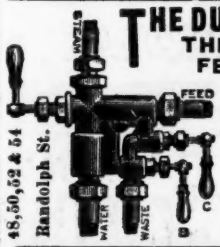

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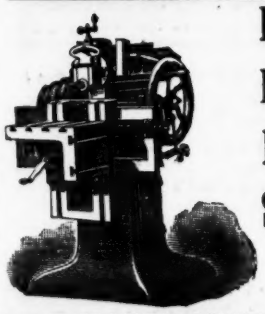

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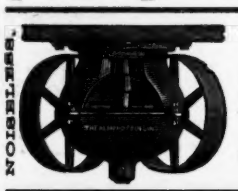

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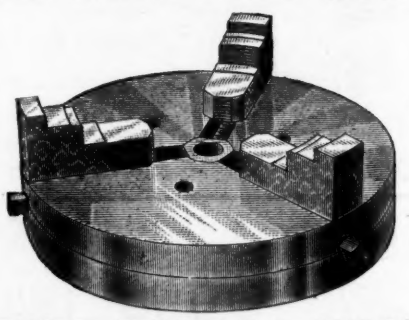

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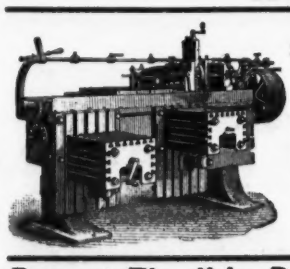

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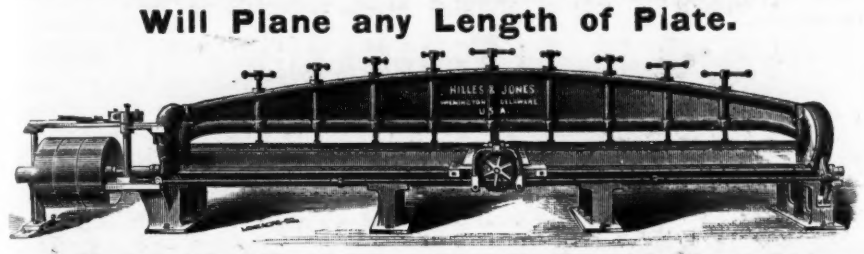

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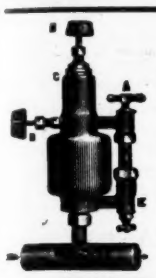

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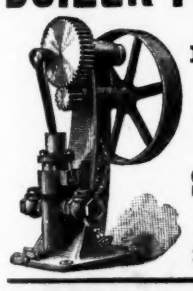

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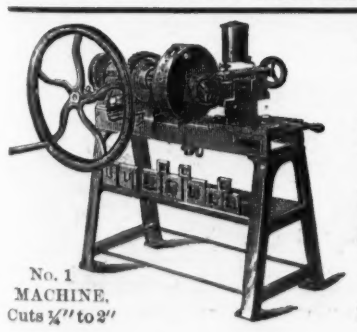

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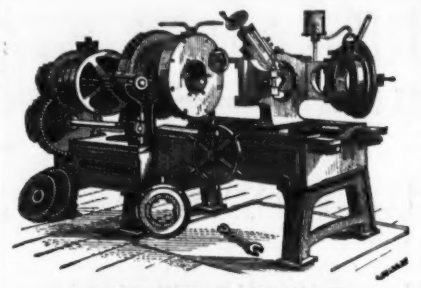

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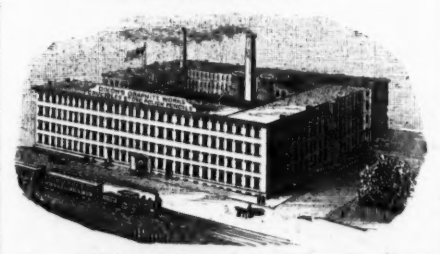

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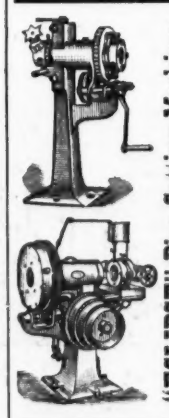

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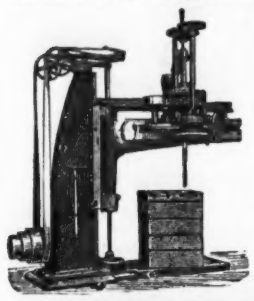

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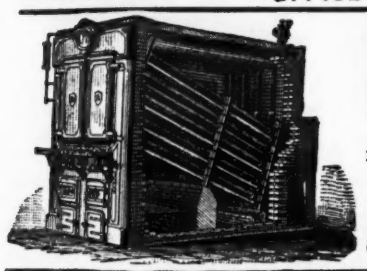

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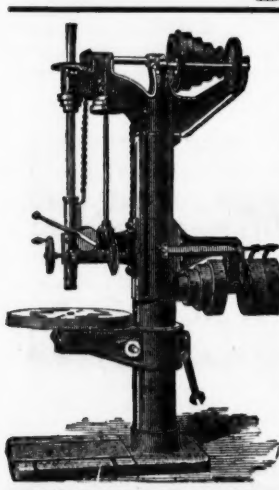

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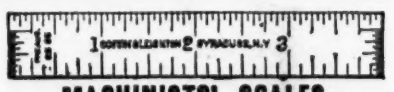

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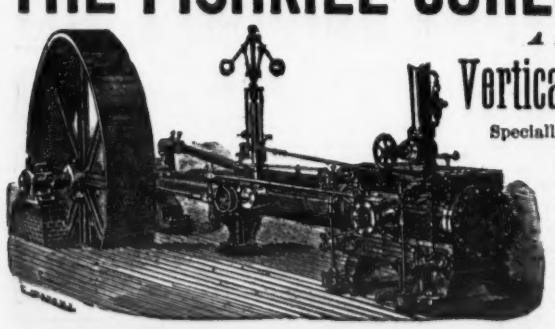

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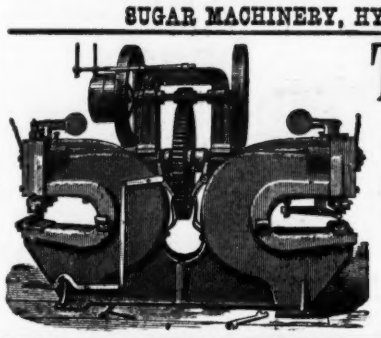

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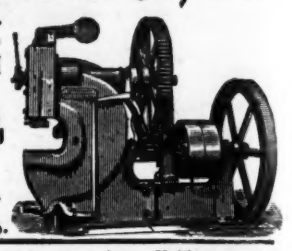

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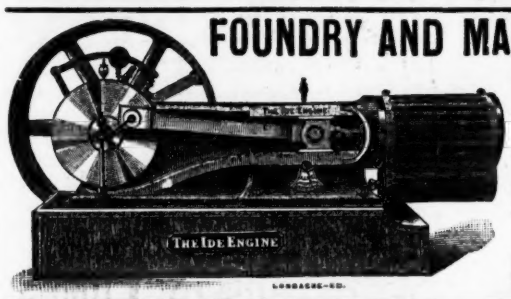

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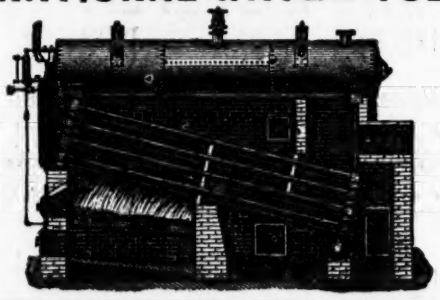

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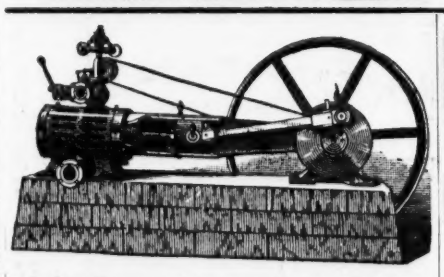

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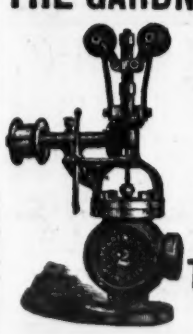

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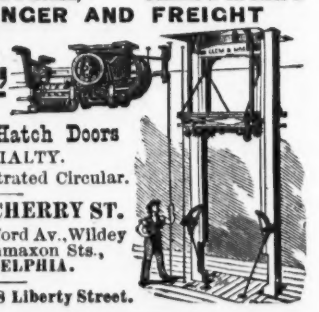

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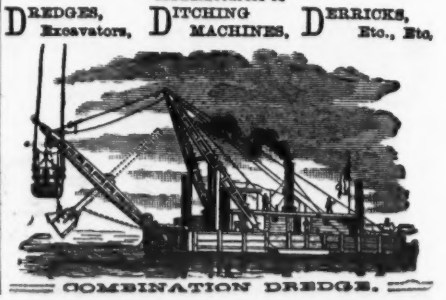

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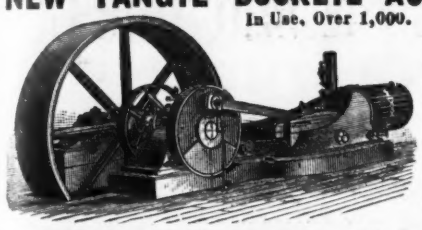

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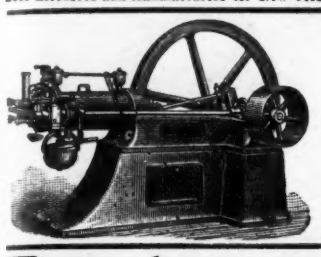

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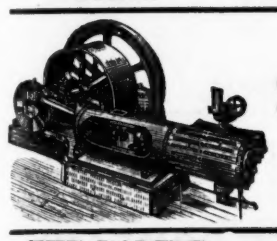

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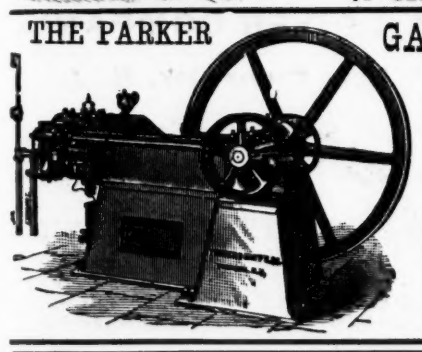

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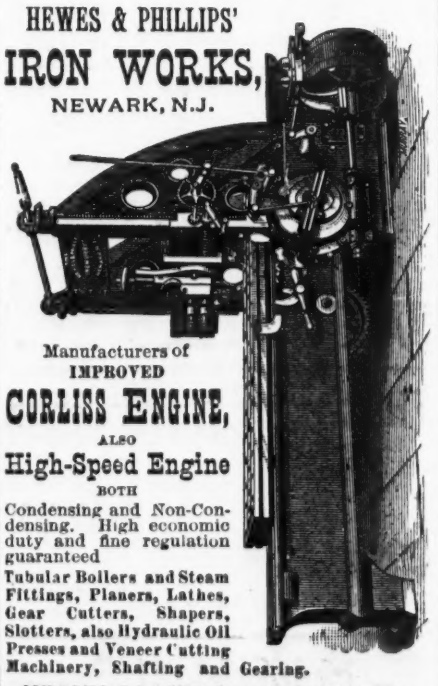

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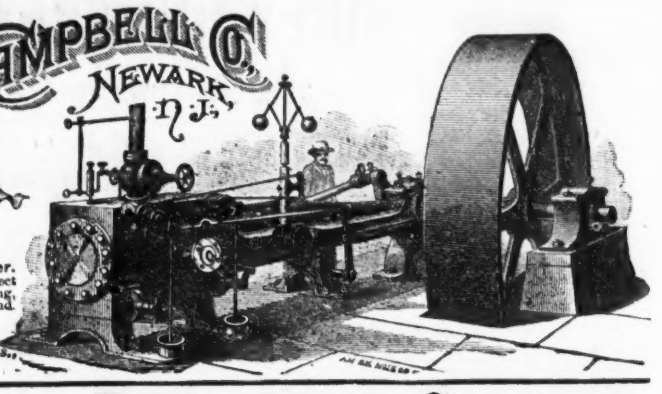

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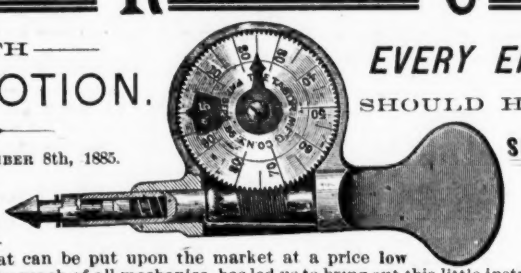

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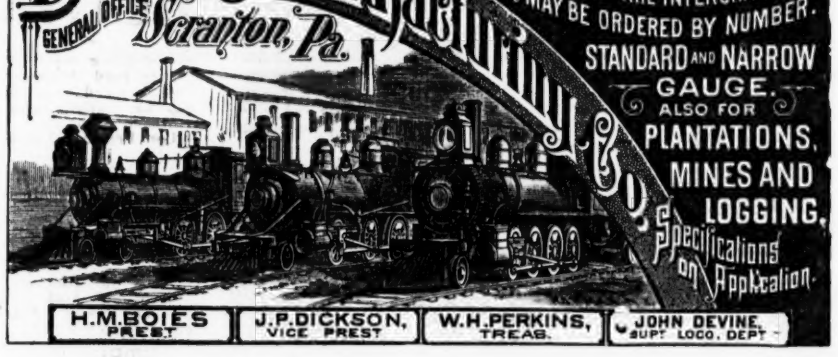

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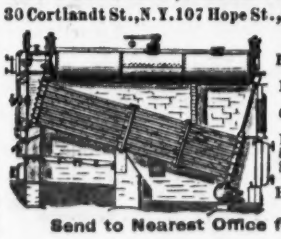

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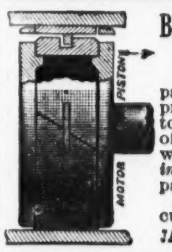

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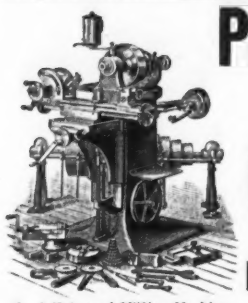

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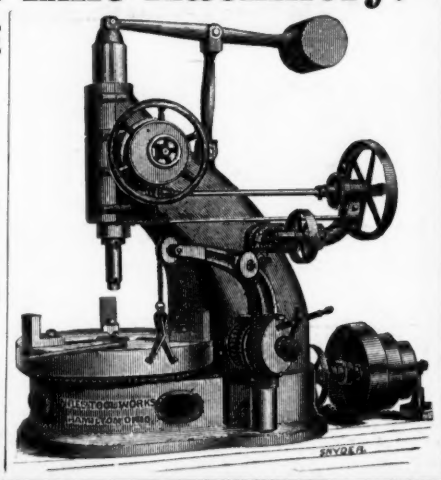

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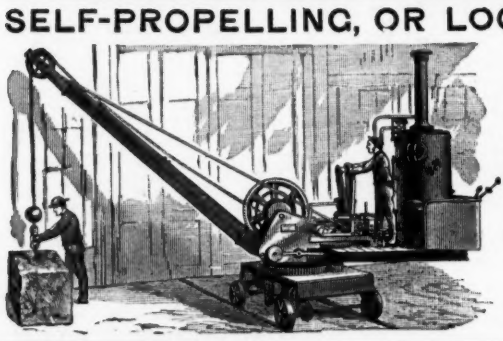

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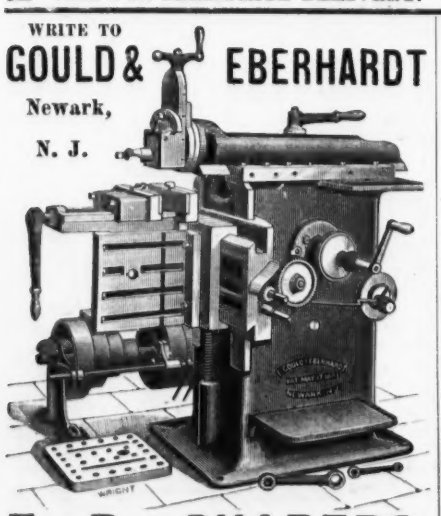

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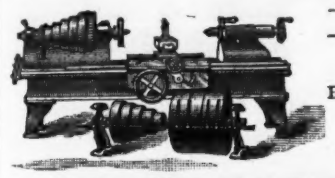

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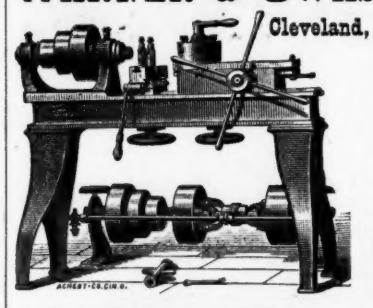

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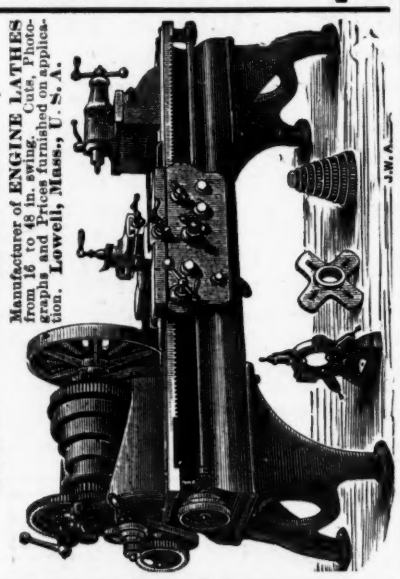

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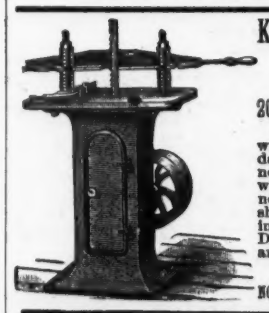

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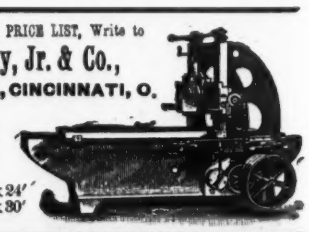

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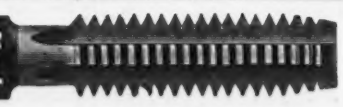

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